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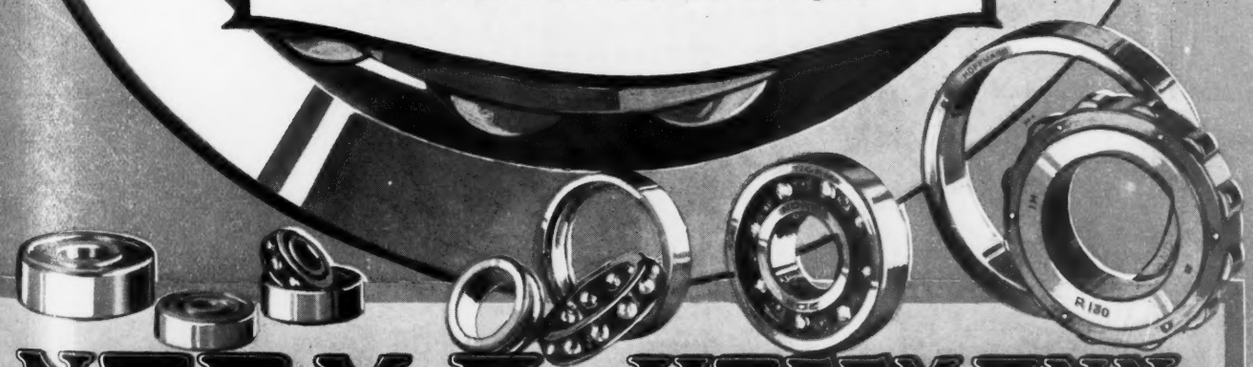

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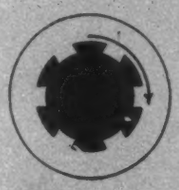

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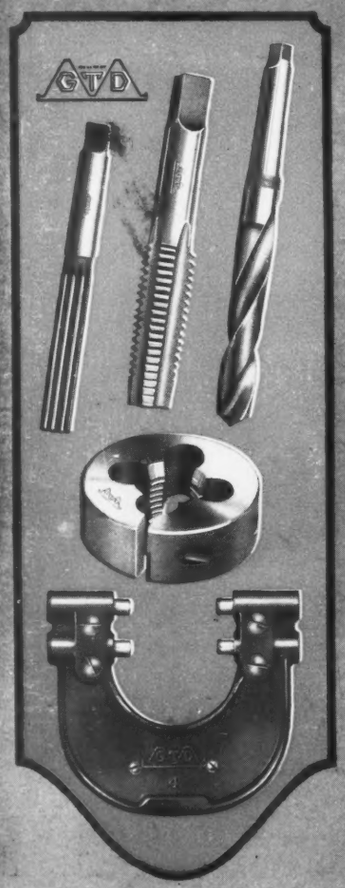

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DESIGN — CONSTRUCTION — OPERATION

Volume 33 NOVEMBER, 1926 Number 3

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The Rise of the Grinding Machine

Twenty-five years ago the grinding machine filled a very small niche in the equipment of a machine shop. First came the tool grinder, which was a long time in use before much development,—but a necessary accessory of every machine shop. Then came cylindrical, internal, surface, face and disk grinders with all their variations; and, last, the centerless grinding machine. With all these variations, some of the ingenious designers who are responsible for the high state of development of the present line say that grinding as a machine shop operation is still in its infancy.

Gradually, various types of grinding machines have been developed so that this type of machine is now capable not only of producing work with extreme accuracy, with high finish and at great rapidity, but also of removing quantities of metal efficiently and economically.

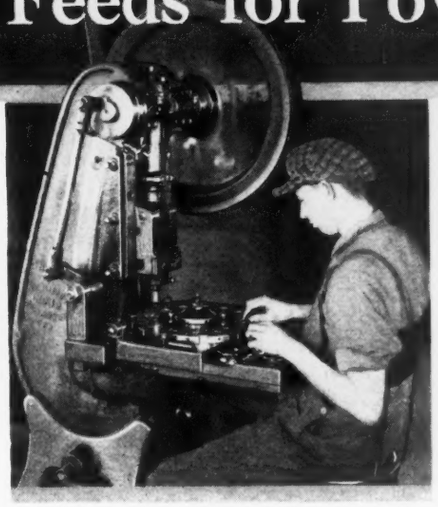
Examples of the economies effected by their use are almost too common to repeat—one where a modern grinding machine costing $4600 replaced three machines and paid for itself in six and a half months through savings in actual production costs as compared with former methods; another where the time for grinding the holes in pinions was reduced from 3.6 minutes to 52 seconds, reducing the cost 75 per cent. The machine with attachments cost $6000 and replaced four old-type machines. The new equipment paid for itself in eight months.

The new centerless grinding machines effect great savings on work for which they are adapted. In one plant an installation of these costing $12,000 paid for itself in three months by reducing actual grinding costs as compared with former methods.

In spite of such well known savings many shops do not use modern grinding machines to as great an extent as they profitably could do. Some superintendents may think that because they use "grinding machines," the requirements for their grinding are covered; but they may be five years behind the machines they actually should be using on their work.

Are you?

Mechanical Feeds for Power Presses



Their Advantages, Relation to the Design of the Press, and Methods of Driving—First of Two Articles

By E. V. CRANE, Mechanical Engineer
E. W. Bliss Co., Brooklyn, N. Y.

MECHANICAL feeding devices of many types have been developed to increase the already high productive capacity of power presses, and at the same time to provide for the safety of the operator as no "safety device" can. In the early days of the press business, crude devices to facilitate hand-feeding began to appear, and these underwent a gradual development toward greater reliability and utility. For the feeding of strip stock, there came, first, the use of a simple stop-pin set in the die; then a finger-gage releasing each stroke, and later the first rough roll feeds.

The rope-driven belt feed of nearly fifty years ago, shown in Fig. 3, was a forerunner of our feeds for secondary operations—the handling of previously blanked or blanked and formed parts. It was followed by dial feeds, gravity feeds, and magazine feeds. Later came the carry feeds for multiple operations, indexing feeds, combinations of simple types of feeds, and the gradual development of complicated highly specialized feeds. An example of development may be seen in Fig. 1, which shows an early Bliss playing-card cutting press which cut sixty cards a minute. A later model of the same machine (Fig. 2) is highly accurate and runs at from 120 to 150 strokes per minute.

Some feeds are built right into the dies—an expedient that may be comparatively inexpensive in first cost, but expensive in the long run, for the feed is scrapped with the die. Some are patchwork affairs, tacked on all over the press, and others are very elaborate, ingenious devices representing high development cost, but often adapted only to special and very high production work. The most satisfactory and economical for ordinary purposes, however, are the more or less standardized feeds, rugged in construction, as simple as possible in detail, and built for general rather than specific work.

Thus, roll feeds are properly built with adjustment to suit the height of die, adjustment for the length of feed, adjustable guides for the width of strip, and adjustment for the tension on the rolls and for the point where the tension is relieved as the punch reaches the strip. These adjustments adapt this type of feed to a wide range of work—wider than is possible with some other classes of feeds, but once satisfactorily developed, they apply to all such feeds. Properly designed, the feed is a practically independent unit, built on a special bolster plate with a driving collar to suit the shaft end, the whole unit being readily attached or removed without modification of the press. Such feeds, well built, are not inexpensive, but they are economical in length of life and the service they give.

Advantages of Mechanical Feeds

When mechanical feeds are warranted on suitable fast presses by a reasonably large production or by the character of the work, they effect economies by increasing the normal production rate or decreasing the labor cost, or by a combination of both. The type of press, the length of stroke, and the work to be handled all affect the speed of hand-feeding. Obviously, strip stock which does not have to be accurately located can be fed very rapidly by hand, and on such work there might be little economy in equipping presses

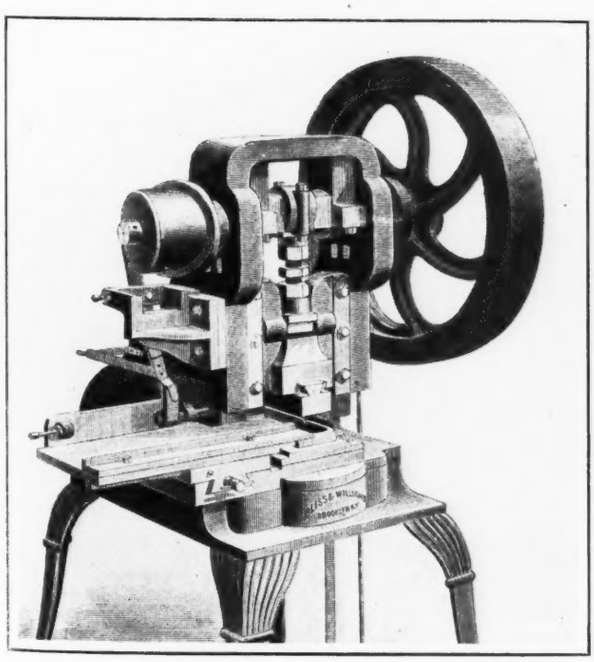


Fig. 1. Early Design of Bliss Card-cutting Press which cut 60 Cards a Minute

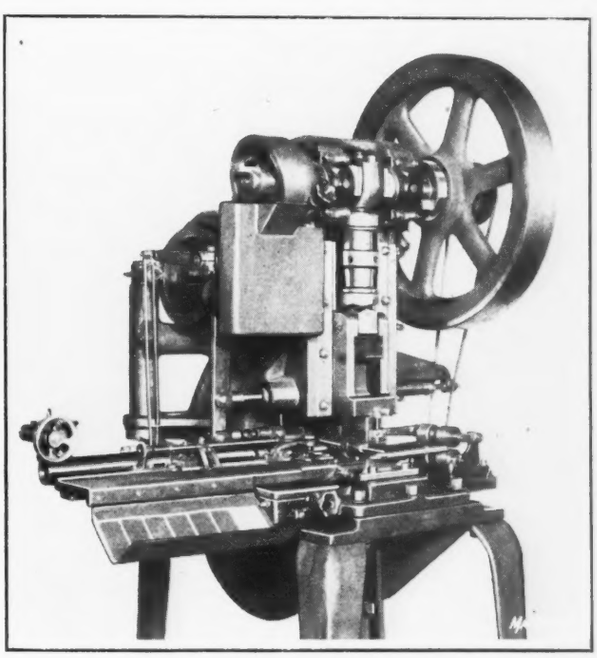


Fig. 2. Modern Card-cutting Press which runs at from 120 to 150 Strokes per Minute

running at less than 30 to 40 strokes a minute with mechanical feeds. Work requiring to be located more accurately, however, or parts that are hard to place correctly in the die, may be fed mechanically to advantage, even at very much lower speeds.

The increase in production effected by mechanical feeding may be due to speeding up the press or to the fact that the feed "catches" every stroke with the press running continuously, while without a feed, the operator may have to trip each time or he may require that the press be run more slowly to feed every stroke. Elimination of the human element also increases the efficiency, for, when feeding by hand, the operator is under more or less of a nervous strain, due to the speed, the element of danger, and the close attention required, which causes a loss of time for rest and lost motion amounting to between ten and twenty minutes every hour. The illustrations Figs. 4 and 5 show two presses of similar size and type, that are used in the same factory for performing almost identical operations. The records showed that the press with the mechanical feed (Fig. 4) produced 25,000 pieces in ten hours, while the one fed by hand produced 13,000 pieces in ten hours.

Decrease in labor cost may be due to having one operator care for several machines or to the fact that a much less skilled operator is required to tend a mechanical feed than to attain good speed by hand. Feeds are either automatic,

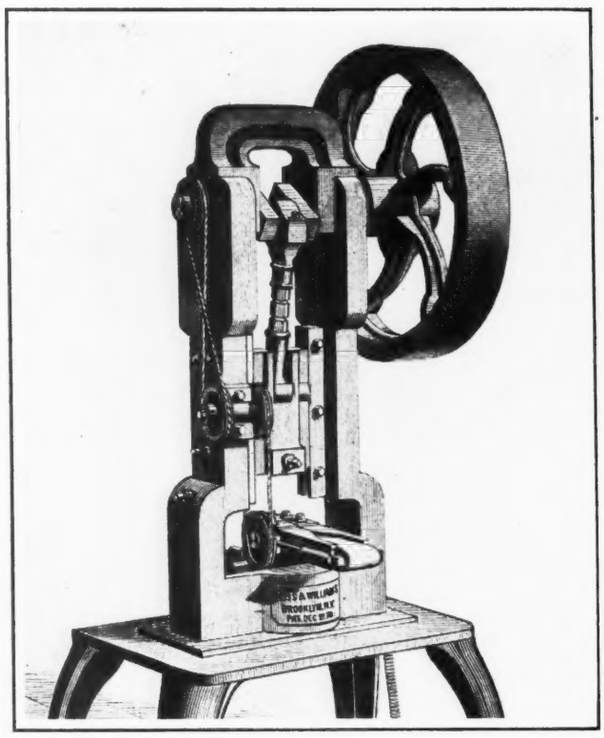


Fig. 3. Belt-driven Feeding Mechanism—a Forerunner of Feeds for Secondary Operations

such as the roll feeds, magazine (or coin) feeds, hopper feeds, etc., which do not require constant service; or semi-automatic, such as the station (or ratchet) dial feeds, friction dial feeds, and drum feeds which require that the operator place each piece, but which automatically carry the work to the die, locate it accurately, carry it away, and eject it. Neither type requires skill on the part of the operator.

Mechanical feeds more effectively safeguard the operator than safety devices. The latter sometimes interfere with and slow down production, and for that reason are often disconnected or removed by operators who are on piece-work. Feeds remove the risk of accident by making it unnecessary for the operator to have his hands near the die. The press shown in Fig. 6 illustrates this point. It is equipped with a station dial feed, and runs continuously on an assembling operation.

Multiple-operation work is often possible in mechanically fed presses, and with excellent economy in many cases, but there are factors that must be guarded against. In such work, it is frequently possible to combine in a single press with a suitable feed, a series of operations, such as blanking and forming; redrawing, piercing, trimming, and sizing. Sometimes this cannot be done on account of the need for an annealing operation at some point in the redrawing, or because of the large percentage of breakage arising from hardening and excessive working of the material. It must

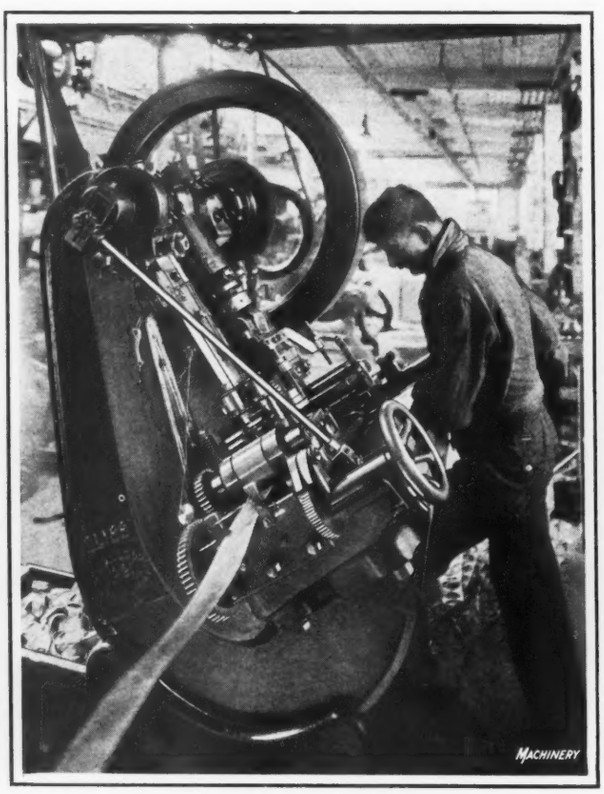


Fig. 4. Press equipped with Mechanical Feed, Capable of producing 25,000 Pieces in Ten Hours—compare with Fig. 5

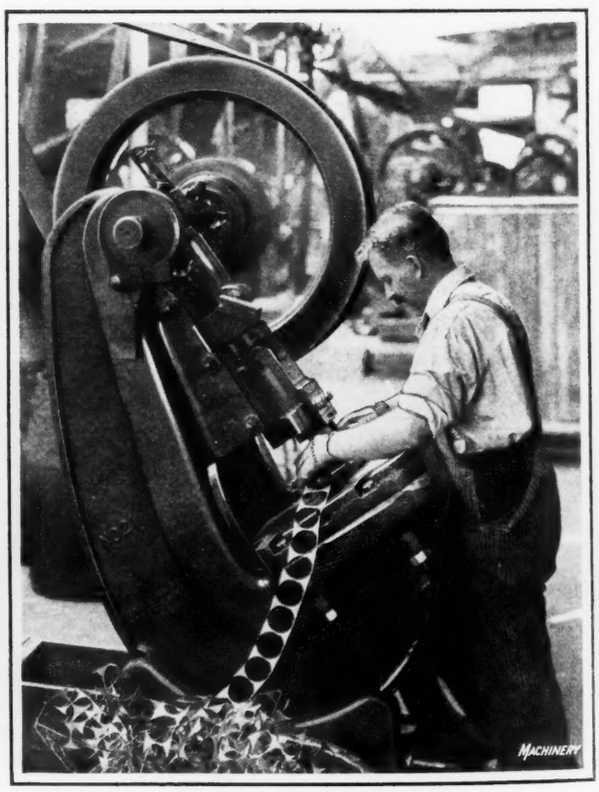


Fig. 5. Hand-fed Press operating on Same Class of Work as Press shown in Fig. 4—Production about 13,000 Pieces in Ten Hours

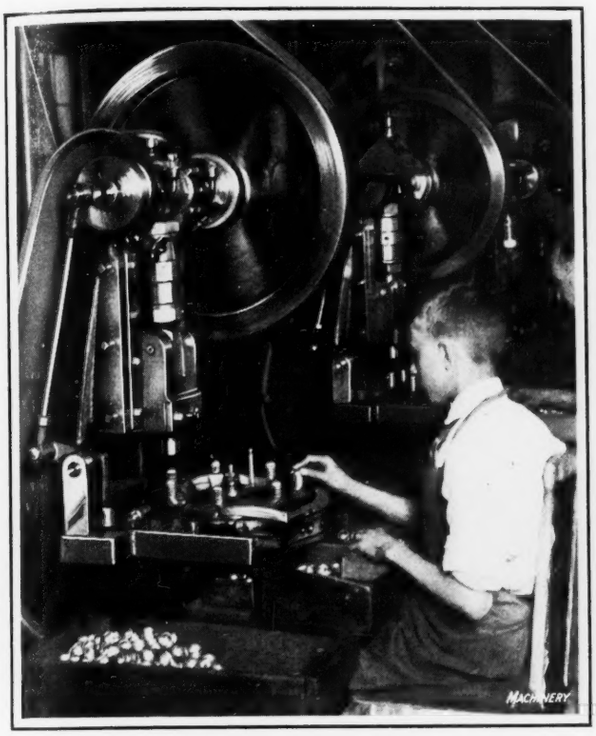


Fig. 6. Mechanical Feeds safeguard the Operator, as illustrated by this Station Dial Feed

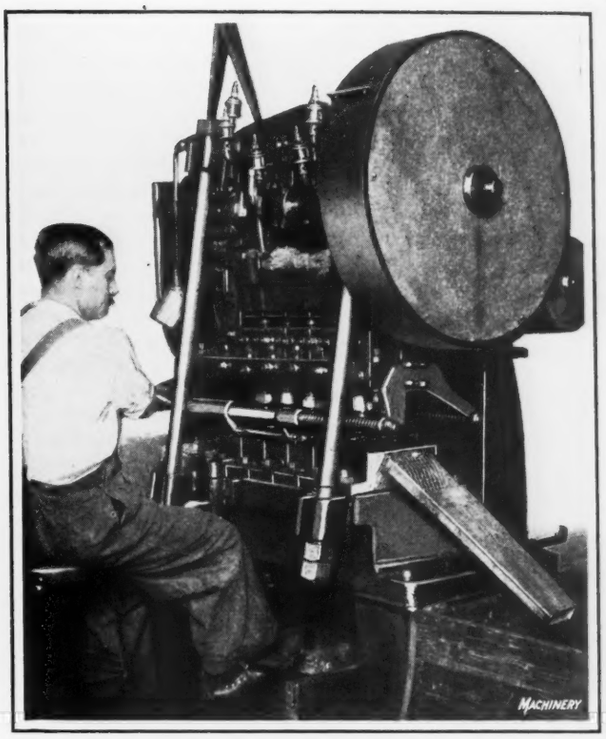


Fig. 7. Press equipped with Separate Slide Adjustment for Each Die and a Special "Carry Feed"

always be remembered, in figuring the advantage from combining operations in this manner, that the time and cost for tool upkeep will be higher than for separate operations, as all tools must be just right at all times, and to repair or adjust one involves lost time on all of them.

It has been demonstrated also that separate means of adjustment are necessary for every punch. This can usually be built into the punch, but it is more economical to use a suitable press built without adjustment in the connection but with separate slide adjustment for each die and a special "carry feed" to handle the work. Such a press is shown in Fig. 7. This press, with five dies, is performing 18,000 separate operations per hour.

Choice of Presses

In selecting a press to be fitted with a mechanical feed, there are a number of factors to be considered. These include type of frame, power, speed, and stroke. Gap (or cut-back) frame presses lend themselves most readily to the application of feeds, and the inclinable feature on some types is of value to effect gravity discharge from the die. Arch-frame and straight-sided frame presses are not so convenient for the arrangement of all types of feeds, but have the advantage of straight-frame spring only, or still less spring in the case of built-up frame presses properly assembled.

It must be remembered that any gap-frame press will spring on an arc about in proportion to the load. The effect of this spring in presses that have not been selected with sufficient care is to cause a less distinct impression at the front in stamping work, and a tendency to wear, especially at the front and back in blanking dies—particularly in those in which there is very little clearance between the punch and die. It was demonstrated in one case, for instance, that the life of expensive dies was increased from about 15,000 punchings per grind to 250,000 by changing to a heavier and stiffer press, although the original press appeared to be handling the work with ease.

As an expedient to minimize unbalanced spring on excessively loaded gap-frame presses, tie-rods are sometimes used, extending from the front of the bed to the crown. Such tie-rods are not to be recommended, but if they must be used, it should only be when they are properly shrunk in against spacing tubes or channels that are carefully fitted between the tie-rod lugs and are of sufficient section for stiffness. In any other case, they will either be so loose as to permit undue spring before they take up fully, or they are likely to be so tight as to spring the press together under a "no load" condition. Correctly shrunk-in tie-rods are more or less permanent, and are therefore suitable only on presses equipped permanently with automatic feeds where they will not interfere with the operation.

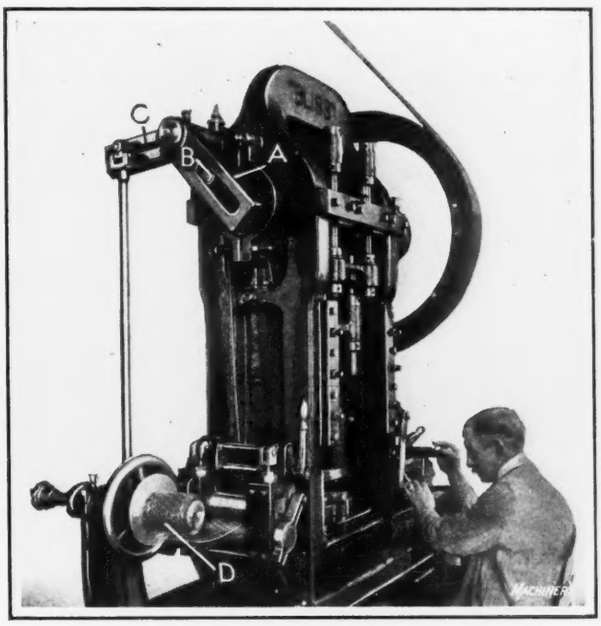


Fig. 8. Double-action Cam Press of Type that positively controls Blank-holder on Both Upward and Downward Strokes

The required strength of the press frame and shaft depends upon the load or pressure to be exerted. The power requirement governing flywheel, gearing, and motor depends upon the stroke and work; that is, the energy to be delivered is the product of the pressure and the distance through which it must act. Thus for short-stroke blanking work, a flywheel press is usually sufficient, but for long-stroke drawing or form-

ing work requiring the same pressure but exerted through a longer distance, a geared press is necessary, as its flywheel runs proportionately much faster and makes available more energy for the same percentage of speed reduction.

During the short portion of the stroke in which the actual work is done, the motor is called on to stand an instantaneous overload of 50 to 75 per cent and a speed reduction of 10 to 20 per cent. It is the flywheel and not the motor, however, which supplies the bulk of the energy to perform the work, and the chief function of the motor is to restore the lost energy (and speed) to the flywheel during the idle time between working periods. It is evident that a press may have sufficient power to "pull" a given job when the press is tripped each stroke and the recuperating period between strokes is long; but when the same press on the same job is fitted with a mechanical feed catching every stroke, the power demand comes oftener, and the recuperating period is shorter, so that more power is demanded of the motor, and a larger motor may be required.

Driving Mechanical Feeds

The matter of driving and timing mechanical feeds properly is a problem in selecting the most suitable driving method and so arranging it as to make the most of the available time in the cycle and to get the smoothest action. Smooth action, uniform acceleration and deceleration, and the design

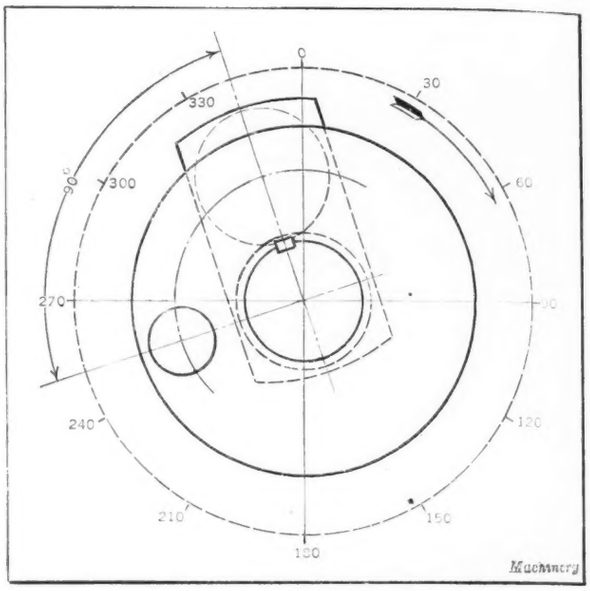


Fig. 10. Relation between Crankpin and Feedpin for Curves A and B, Fig. 9

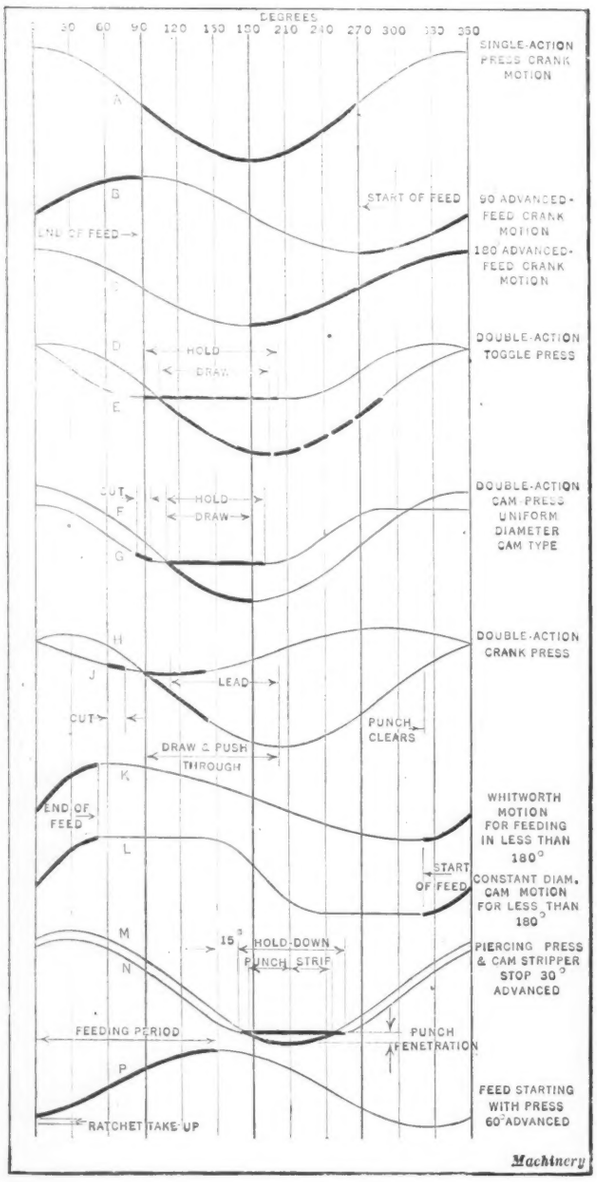


Fig. 9. Curves illustrating Different Feed and Slide Motions through One Complete Cycle or Revolution on Presses of Different Types

of parts so that the possibility of wear and backlash occurring is reduced to a minimum are essential in securing and maintaining accuracy and reliability. The action of a feed mechanism is necessarily intermittent and fast, and even under good conditions, it is not easy to continually start and stop an appreciable mass rapidly without developing wear on the working surfaces. For this reason, simplicity, use of the fewest parts with the greatest ease of adjustment or replacement, and use of the best materials are necessary for economy.

Most press-feeding involves one uniform motion, in the same direction, at each stroke of the press. In the majority of cases, this is derived from a crank or a cam on the free protruding end of the press crankshaft, although in some cases sprockets, gears, etc., are used in connection with clutches, grippers, or friction devices. In general, where there is a choice, a crank motion is decidedly preferable to a cam motion, because it can be run faster, is easier to adjust and maintain, and is much cheaper to construct.

The curves shown in Fig. 9 illustrate the lineal motion of several feed arrangements and of the slides of typical presses, each through one complete cycle (one revolution of the press crankshaft), beginning from the normal rest position. The use of such charts in laying out feeds is advisable in order to check the essential points, and avoid (1) interference between the action periods of the press slides and the feed; (2) sharp jerky motions; (3) wasted time in the cycle which might be used in slowing down the feed action.

Curve *A* represents the motion (simple harmonic motion) of a crank-actuated press slide. The working portion of the stroke on single-action crank presses is considered in most cases to be up to half (the lower half) of the down stroke or from 90 degrees to 180 degrees (nearly) as the shaft revolves. If all of this is used, then another full quarter turn will be required on the up stroke to bring the punch clear. This leaves a full half turn (180 degrees), from 270 to 90 degrees, for feeding. If a straight crank motion is used, it requires this remaining 180 degrees for the feed stroke. The feed is usually arranged on the up stroke of the crankpin to bring the connecting-rods into tension while feeding.

Curve *B* represents a simple crank-driven feed motion, with the feed crankpin 90 degrees in advance of the press crankpin, as indicated in Fig. 10. This brings the feeding action on the up stroke and, provided the connecting-rod works vertically, the feed begins at 270 degrees and finishes at 90 degrees. This drive is suitable for dial or roll feeds and the like, provided the working portion of the stroke is completed and the punches are clear again in less than 180 degrees. This is necessary because the dial or strip material

passes under the punches in feeding, and obviously, there must be no interference. Comparison of curves *A* and *B* will show that this feeding action begins after the punch has left the lower half of its stroke, and is completed before it starts the lower half again.

Curve *C* represents the crank-driven feed motion with the feed crankpin advanced 180 degrees ahead of the press crankpin. Such a drive is suitable for some magazine feeds and special push feeds, where the first part of the feed stroke is to pick up a slug from a stack, and the last part (90 degrees or less) is to deliver it to the die, or where a portion of the feed mechanism must cross the die and return it in locating the work. For the first case, this timing has the advantage that the feed is completed before the stopping position of the press is reached—a favorable point when setting up and adjusting.

Double-action presses in general, and single-action presses in some cases, are not suited to the plain crank drive previously described, on account of not having a full half cycle (180 degrees) available for the feed action. This applies only, of course, to roll and dial feeds and the like, in which the work or the feed itself travels under the punches through the whole feeding stroke.

Curve *E* is typical of the action of the blank-holder slide on a double-action toggle press, as compared with the punch-slide action represented by the curve *D*. These presses are usually stopped about 15 degrees ahead of top center, as this is the highest point reached simultaneously by both slides. The blank-holder dwell is arranged to start before the punch reaches the material, and to hold until about 10 degrees after the draw is completed. There remains about 135 degrees during which the work space is clear for feeding.

Curve *G* typifies the blank-holder action and *F* the punch-slide action of double-action cam presses of the type that have constant-diameter cams for positive control of the blank-holder on both the upward and the downward strokes. Such a press is illustrated in Fig. 8. Here the outer slide may perform a blanking operation before the dwell begins, after which it holds the blank until, say, 10 degrees after the draw has been completed. In this case, there remains about 155 degrees during which the space under the punches is available for feeding. There are cases where this is reduced materially by the feed itself, as for instance, in the station dial feed having dial bushings of considerable height so that they raise the point at which the punches enter and leave above mid-stroke. Such a condition may occur occasionally on any type of press.

Curves *J* and *H* represent the slide motions of double-action crank presses which are used for high speed and comparatively shallow cut and draw work. Crank instead of cam operation of the outer slide (curve *J*) makes possible a faster working speed, but necessitates working higher on the stroke in order to combine the most effective holding and the fastest drawing speed, as indicated. The cutting action comes even higher up, so that the space available for feeding, during which both punches are clear, is reduced to only about 90 degrees.

Curve *K* represents a quick-action feed motion which can be timed to suit presses having less than 180 degrees available for feeding. The drive in this case is the Scotch yoke quick-return motion. The press shown in Fig. 8 is fitted with this type of drive. On it, the yoke *A* is driven by the pin *B* on the press shaft, and adjustment is provided at *C* to vary the feed stroke.

Curve *L*, Fig. 9, represents another quick-action feed motion which can be designed to suit feeding periods of less than 180 degrees. The drive in this case is from a cam of the constant-diameter type, having rolls top and bottom, so that the action is positive on both the up and down strokes. On this drive, one of the rollers should be provided with an eccentric pin to take up any wear or lost motion. This type of cam has some advantages over others on account of its positive action, but the lay-out and cutting must be accurately done. Cams of any type are expensive to make, subject to wear, and limited as to operating speed, so that in general, crank actions should be given the preference.

Curve *M* represents the action of the slide of a press used for perforating or piercing. This press is equipped with a cam-actuated stripper (curve *N*), which also serves to minimize the deformation of the stock due to punching a large number of holes and to guide the slender punches. Note that the cams in this case are so designed that there is no motion between the punch slide and the stripper slide until the bottom of the stroke where the holding takes place. The feed represented by curve *P* is driven by an ordinary crank motion, but the press is stopped 30 degrees back of the dead center, and the period of "take-up" between the ratchet and pawl is taken advantage of, so that the feed does not actually start until the press starts. This is of advantage in locating the sheets in the grippers accurately.

The curves shown cover quite completely the various common types of power presses and the actions of desirable feed drives. Many modifications and combinations of these are possible. However, the essentials in every case are smoothness, positiveness, and simplicity in the drive, and accuracy, adjustability, and simplicity in the feed.

* * *

MEASURING FINISH OF MACHINED SURFACES

At the Production Meeting of the Society of Automotive Engineers held in Chicago, September 21 to 23, C. S. Stark, of the Packard Motor Car Co., read a paper in which he described a method that may be used for measuring or gaging the degree of finish on a machined surface. He pointed out that inspection methods relying entirely on the judgment of individuals introduce difficult problems. Nevertheless, some kinds of workmanship cannot be measured by exact mechanical means, but must be determined entirely by an inspection that relies upon judgment rather than positive measurements.

Industry is constantly seeking mechanical means for inspecting properties of materials and finished products, the inspection of which formerly depended entirely upon judgment. At the Packard plant experiments have been made to obtain a reliable means for actually measuring the degree of finish of a machined surface.

There already are means for discovering very slight cracks in ground surfaces—cracks that cannot be seen even with a microscope. This is done by magnetizing the part in question and immersing it in a solution of kerosene oil having very fine iron dust suspended in it. A magnetic field immediately surrounds the crack and the fine iron particles adhere in a peculiar shape to the hardened surface where the surface crack appears. This method of inspection however, has to do only with the quality of the surface, but not directly with the actual degree of finish.

With a view to obtaining a positive measure of finish, the inspection department of the Packard Motor Car Co. several years ago began a search for some means of obtaining a positive indication of "degree of finish." After some experimenting it was decided that the reflection of the finished surface could be taken as a measure of its surface finish. By the use of a photo-electric cell, a reliable indicator of finish may be obtained. It has been found that when this cell is connected in a suitable amplifying circuit to a milliammeter, the ratio of the values read on the scale of the milliammeter gives very accurately the degree of the polish or finish on the surface of the sample being tested.

The sample is simply exposed to a source of light, and the light is reflected against the photo-electric cell. After some standard has been adopted which may be called the unit of finish, the finish on the parts compared with it can be read off mechanically from the deflection of the needle on the scale of the milliammeter.

Such a device has proved successful in actual operation, and while this type of instrument may still be considered as being in its infancy, it is possible that it will be used for other purposes besides indicating degree of finish. This instrument is not expensive, its cost being from $100 to $150, and the results have been well worth the expenditure.

Care and Installation of Belts

By JAMES H. RODGERS

FEW pieces of manufacturing equipment receive less attention than the belting that transmits the power from the lineshaft to the various machines. It is apparently taken for granted that all that is required is a tight belt. If the belt is slack, a piece is taken out, the ends joined, and the belt replaced. This is all very well if done with a practical knowledge of the necessary requirements.

All experienced men appreciate the advantages of a well spliced endless belt, but how many well spliced belts do we find in the average shop? The general practice is to cut the belt to the desired length and join the ends by means of lacing or metal fasteners. There are many types of fasteners that give satisfactory service, and when careful attention is given to the joints, they are effective for continuous drives. Nevertheless, leather lacing will doubtless continue to be used for belt repairs, due to its simplicity and convenience.

Small Lace Holes Should be Used

It must not be taken for granted, however, that all one has to do in making belt joints is to cut a piece from the end of the belt, punch a few holes, and secure the ends again with a lace, to obtain an effective drive. The details of a properly made joint may seem of little import, but the operation of the belt depends largely on the consideration given to this matter.

In repairing a belt, the beginner generally makes the lace holes of large size, as indicated at *X*, Fig. 1. The result of such practice is shown at *Y*. With few exceptions, a belt will tear across the lace holes and will seldom fail in a direction parallel to the belt length. For this reason, the amount of the leather cut out should be kept as low as possible, consistent with the size of the belt and the thickness and width of the lace.

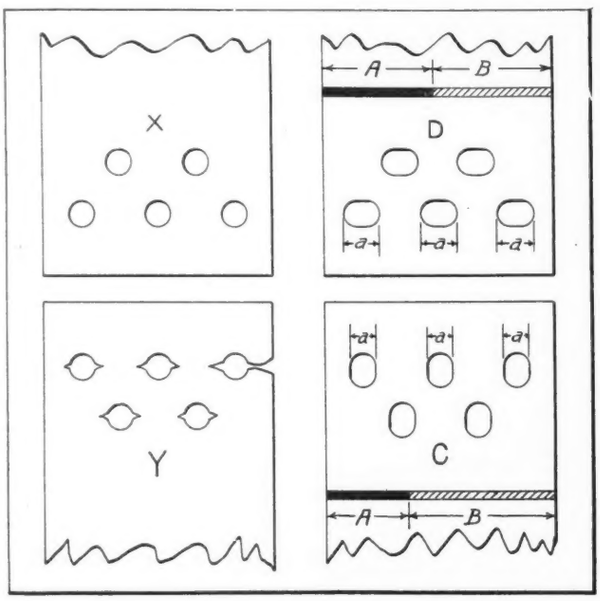


Fig. 1. Belt Ends with Correct and Faulty Lace Holes

When it is necessary to enlarge the holes, this should be done as shown at *C*, Fig. 1, and not as at *D*. The reason for this will be obvious when comparison is made between the efficiences of the belt in each instance. The heavy black line indicates the portion of the width cut away by the holes, while the shaded section represents the remaining material of the belt available for belt stress. With the same opening for the belt lace, the method shown at *C* is 15 per cent more efficient than that at *D*.

Which side of the belt is better to run on the pulley appears to be a debatable question, as many favor the hair or smooth side, while others prefer the rough side. However, as the efficiency of a belt drive relies, largely, on the frictional contact between the surfaces, it would seem logical that the smooth side should have the preference. Another factor in its favor is that the portion of the belt having the greatest tensile strength is near the flesh or rough side. This is specially important when belts run on small pulleys.

Care Necessary in Making the Joint

An essential factor in a belt joint is that the ends be square with the run of the belt. In cutting a belt, it is always advisable to use a try-square, as shown at *A*, Fig. 2. Unless this is done, the tendency is to make an angular cut, as at *C*, so that when the joint is laced, it appears as at *D*. In passing over a pulley, the belt develops a tendency to oscillate, and such a condition is aggravated when the belt is running a little loose.

To prevent it from jumping off, a stick is frequently secured to some rigid support and extended down at the side of the pulley, as at *E*. This, however, provides only a temporary remedy, as the weakest part of the belt—the laced joint—is continually brought into violent contact with this "guide," and eventually the serviceability of the joint is destroyed. When guides are considered necessary to correct a faulty installation or repair, they should take the form of rollers.

To assist in keeping the belts running in the center of the pulley, the face of the pulley is usually given a slight crown. This crown also compensates for any slight error in the alignment of shafts or pulleys. In the past, it was common practice to give the pulley a conical crown, but the more modern method is the spherical crown, which gives more effective service. A comparison of these two methods is shown in Fig. 3. It will be seen that in the conical crown there is a pronounced breaking point *A;* this is not very serious, perhaps, but nevertheless has a tendency, particularly in new and heavy belts, to leave air spaces at the edges of the belt, as at *B*. The spherical method shown in the view at the right, is obviously an improvement. Here the surface forms an arc, and equalizes the bending stresses throughout the belt width, resulting in a more uniform contact.

Belt Dressing Should be Used Sparingly

To increase the driving qualities of a belt—or rather, to increase the pull—the application of belt dressing is frequently resorted to, and when judiciously applied, dressing may add materially to the effective operation of a belt; but when applied carelessly or thoughtlessly, the practice may not only prove inefficient, but destructive to the belt.

The driving power of a belt depends upon its flexibility and adhesive qualities; therefore, the composition of a belt dressing must be such that it will retain these essential requirements. The adhesive action may be increased by judicious application of dressing, but pliability can only be obtained by a liquid or semi-liquid preparation that will penetrate the pores of the belt. When properly used, a surface dressing will often prevent slipping, but if constant applications seem necessary to maintain the "pull," steps should be taken to eliminate this necessity, which generally can be traced to faulty installation or maintenance conditions.

Where the "belt stick" is freely but thoughtlessly applied, it is not an uncommon thing to see pulleys in the condition shown in Fig. 4, where large patches of the dressing *A* are

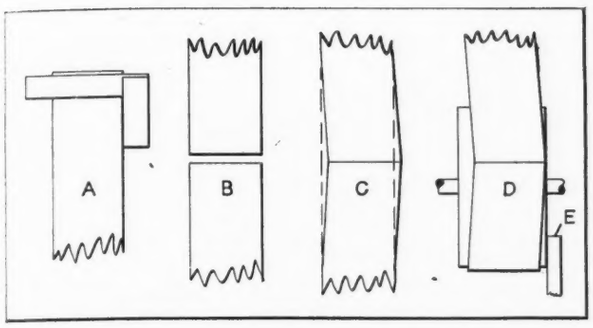


Fig. 2. Properly and Improperly Cut Belt Ends

shown clinging to the surfaces. As previously stated, a belt derives and transmits its power from frictional contact with the pulleys, and while the pull from a well "dressed" belt may seem better, the general efficiency is not increased. The air pockets formed between the patches on the pulley surface, as indicated in Fig. 4 and the additional effort required to separate the belt from the lumps of dressing as it leaves the pulley decreases the efficiency. A stamp may easily be placed on an envelope, but some effort is required to remove it. At your next opportunity, notice a drive of this kind and listen to the tearing noise when starting or stopping.

However, the effect of excessive use of belt dressing is more pronounced on cone pulleys, where belts are required to be changed from one step to another. The action of the latter is very similar to that of the straight pulley, but where the greatest trouble is caused is on the flange or shoulder. The accumulation of the dressing on this vertical face soon attracts the edges of the belt, with the result that it shows a marked tendency to climb to the next higher step—and very often succeeds—the inevitable consequence being a broken belt or lace—generally the latter.

At other times, the belt may climb, but instead of mounting to the next step will twist completely over. The writer has seen this happen many times. Excess dressing must be removed immediately. Even without the application of dressing, belts on cone pulleys frequently develop a tendency to

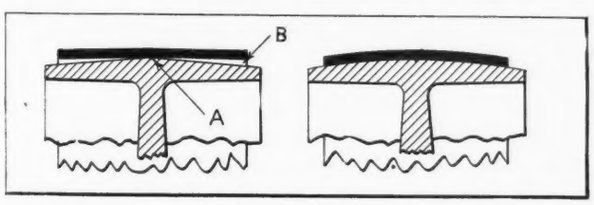


Fig. 3. Sections of Pulleys, showing Conical and Spherical Crown

climb, due to faulty belt or pulley alignment. To assist in the proper running of the belt, the flanges or shoulders should be under-cut, as shown at *C*, Fig. 4. This provides a point of contact for the belt at *E*, the edge being kept clear of the flange throughout the entire wrap of the pulley.

Direction of Belt Travel

Another controversial factor in connection with leather belts is spliced joints and their relation to the direction of travel. It is evident that the thin edge of the lap may show signs of parting after a period of service. For this reason, some contend that the belt should be run with the splice as shown at *B*, Fig. 5. On this principle, the action of the pulley will aid in keeping the thin edge down in place.

On the other hand, some belt men say that the action of the air on the belt surface when in motion tends to lift the edge from its place. As the air action is greatest when the joint is passing around the pulley, it would appear that the subject is open to discussion. However, as slow running belts are not subjected to excessive air action, it might be said that the method shown at *B* would be best, and that at *C* better suited for high-speed belts. In double- or three-ply belts, these splices could be arranged to meet both the conditions mentioned, as indicated at *A*.

The fact that slippage is present to a certain extent in every belt drive must not be overlooked. This brings two opposing conditions into consideration—the drive pulley slipping within the belt, or the belt slipping on the driven pulley. In the former case, the direction of splice indicated at *C* would be better, whereas, for the latter, that shown at *B* would be more effective in keeping the thin edge of the lap in position. Irrespective of the advantages claimed for either method, the entire question seems to be one requiring careful attention in the matter of repairs and maintenance, so that faults may be remedied as soon as they are observed.

Avoid the Use of Small Pulleys

In the use of double or triple belts for high-power drives, care should be taken to use pulleys as large in diameter as possible, consistent with the speed requirements. This is quite clear when we consider the lack of flexibility of the

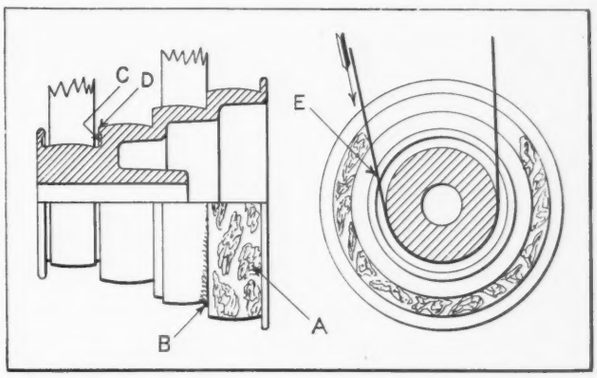


Fig. 4. Pulley gummed with Belt Dressing

heavier belts. Another argument against the small pulley is the imperceptible creeping action of the belt in making the round of the small pulley. It is obvious that two opposite forces are at work when the belt is on the pulley—that of compression on the inner side and tension on the outer side. These forces are neutralized between the curves, but immediately come into action again when the pulley is reached. For instance, suppose the length *X–X*, Fig. 5, represents the length of that portion of the pulley circumference in contact with the belt. The length of both sides of the belt between *X–X* will be the same, but not so when the same section is wrapped about the pulley, as at *Y–Y*. If the contraction of the inner side equals the expansion of the outer side, the center length will remain unchanged; but such is seldom the case, so that the tendency is to destroy the adhesion of the two layers, as shown at *D*.

Example of Faulty Practice

A leather-covered wooden pulley that came to the notice of the writer some time ago was quite interesting. This pulley was located on the end of a lineshaft, and was utilized to drive the countershaft of a buffing machine on the floor above. The buffer was subjected to severe service, frequently causing excessive slipping of the belt.

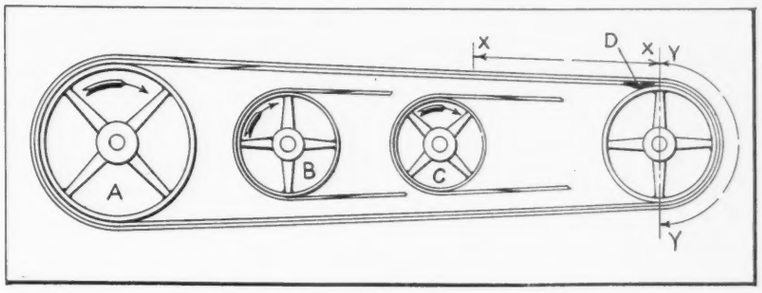


Fig. 5. Methods of splicing Belts

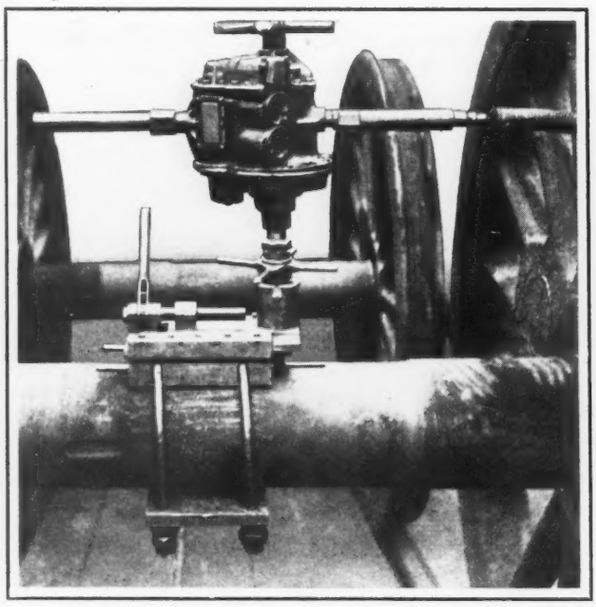


Fig. 1. Milling Keyseat in Driving Wheel Axle

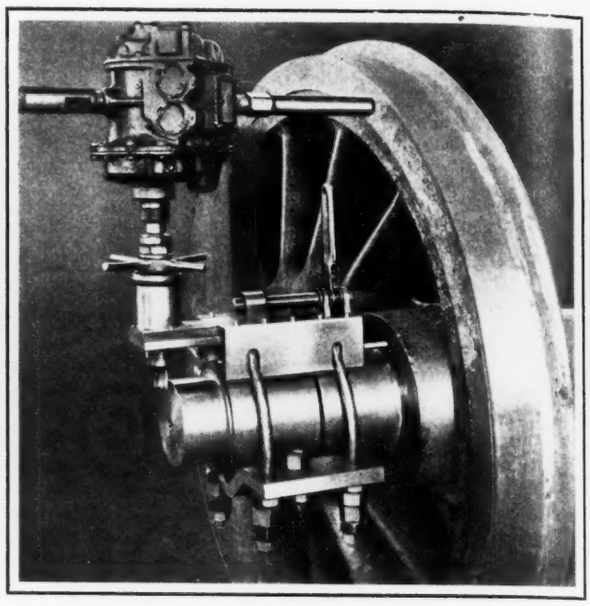


Fig. 2. Milling Keyseat in End of Crankpin

Upon one occasion, the writer was called upon to repair the main drive belt. Investigation showed that the belt was in a very dark storage room, and could only be examined by means of a special extension light taken to the ceiling. As stated, the pulley was found to be covered with leather, but a glance at the belt showed a strip right through the center, on the inner side that was in a deplorable state. Looking at the pulley for the cause, it was discovered that the leather covering had been put on with nails, and several of these were protruding over 1/8 inch. In this particular instance, the nails were removed and replaced by fine wood screws, which proved satisfactory.

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MACHINERY TRADE OF CHINA

The total imports of industrial machinery into China during 1924, complete statistics for which have just become available, amounted to $18,672,000. This shows a falling off from the imports of 1922 and 1923, due largely to the political conditions in China, which of late have been somewhat unstable. Compared with pre-war imports, however, the 1924 volume shows a remarkable increase. It is four times the average value for the pre-war years 1910 to 1913, inclusive. Even allowing for the difference in prices of machinery, the imports in 1924 were about two and one-half times the average annual tonnage imported immediately before the war.

A study of the participation of the machinery-producing countries of the world in the Chinese trade, as made by the Industrial Machinery Division of the Department of Commerce, reveals some significant developments. Great Britain supplied about 30 per cent; the United States and Canada, 20 per cent; Japan, 19 per cent; and Germany, 17 per cent of the Chinese machinery imports in 1924. Previous to the war, Great Britain supplied 38 per cent; Germany, 18 per cent; Japan, 9 per cent; and the United States only 7 per cent. The position of the United States, therefore, has materially improved.

China imported in 1924 more than half a million dollars worth of machine tools—the exact value being $529,900, as compared with $393,590 in 1923. Previous to the war, the average annual imports of machine tools for four years were valued at only $21,270. In the machine tool market, the United States held first place in 1924, supplying 29 per cent of the total imports with a value of $153,000, closely followed by Japan with a share of about 25 per cent. When this situation is compared with pre-war years, it will be seen that Great Britain has lost the preeminent position it held in this market, while the imports from the United States and Japan have increased greatly.

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PORTABLE KEYSEATING MACHINE

By E. A. MURRAY, Shop Superintendent
The Chesapeake and Ohio Railway Co.

The portable keyseat milling machine shown in the accompanying illustrations is especially adapted for milling keyseats either in driving wheel axles (for holding eccentrics) or in the ends of crankpins (for holding eccentric cranks in position). Fig. 1 shows this device applied to a driving wheel axle, and Fig. 2 illustrates its application to a crankpin. The base of the machine is held in position by four curved eyebolts connected with a bottom plate, as shown. The milling cutter spindle is mounted in a horizontal slide *B* (Fig. 3), which slides in base *A* and is given a feeding movement by screw *C* and hand-operated ratchet lever *D*. The cutter-spindle is set in the right vertical position by means of the threaded sleeve *E*, and it is locked in position for milling by screwing down lock-nut *F* until it engages the top of the hub on slide *B*. Sleeve *E* has twelve threads per inch, and feed-screw *C* the same pitch. Shank *G* connects with an air motor.

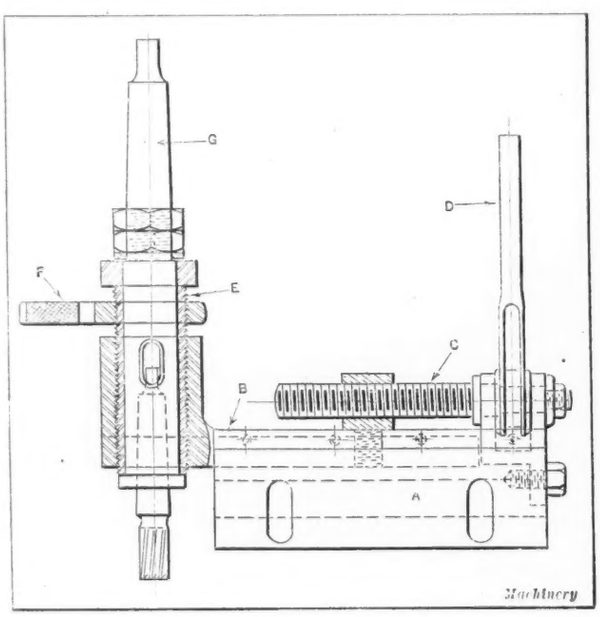

Fig. 3. Construction of Portable Keyseating Machine

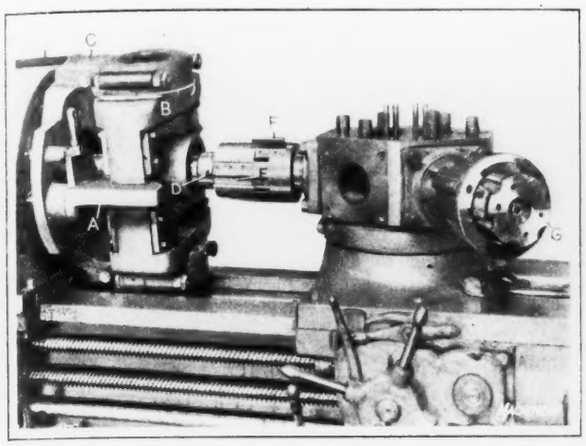

Fig. 1. Indexing Chuck and Tooling Equipment employed in boring, reaming and tapping the Two Ends of Pipe Couplings in One Operation

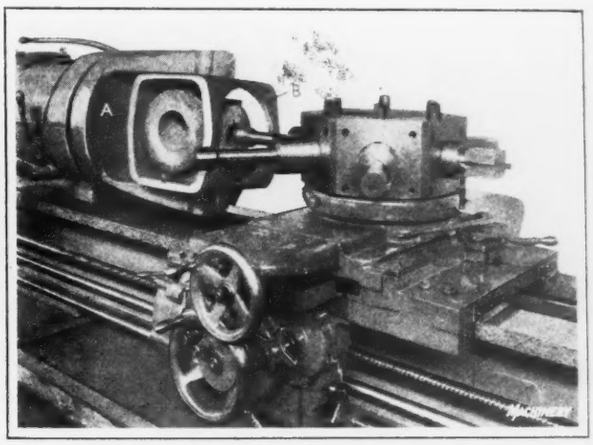

Fig. 2. Operation in which Two Ends of Gate Valve shown in Fig. 5 are finished by the Use of an Indexing Chuck

Indexing Chucks for the Turret Lathe

Chucks that Enable Both Ends of a Part to be Machined in One Operation

WHEN parts can be completely machined in one operation or chucking, it is usually an easy matter to finish the various surfaces accurately in the proper relation to each other. Also, the production time per part is invariably less than when two or more chuckings are involved. To obtain these advantages in machining certain parts that are finished on both ends, the International Machine Tool Co., Indianapolis, Ind., recently equipped several turret lathes with indexing chucks. In these chucks, the work can be turned end for end without being unclamped, so that the two ends can be finished in one operation. Chucks have also been developed by this company for finishing three and four ends of such parts as valves in one operation.

Reaming and Tapping Pipe Couplings

The equipment illustrated in Fig. 1 was provided on a turret lathe sent into the oil fields, and enables both ends of pipe couplings to be reamed and tapped in one operation. The machining of both ends is possible because the chuck can be conveniently indexed to bring either end of the work toward the hexagon turret on which all the tools are mounted. Couplings with matched threads can be produced, which is one of the requirements of some manufacturers. From 2- to 10-inch pipe can be finished with this equipment, and standard pipe threads of 11 1/2 per inch are cut.

The couplings are produced from a piece of seamless steel tubing which is held between vertical adjustable jaws in the chuck. These jaws have steel inserts where they grip the work, and different sizes of jaws are provided to take care of various sizes of couplings. To index the work after one end has been completed, it is only necessary to disengage latch *A* from the work-holding part *B*, after which part *B* can be completely turned in the bearings of part *C*, the latter being mounted on the spindle of the machine. An indexing pin insures accurate settings of the swivel member in both positions.

In the illustration, the reamer is shown about to enter one end of the tubing. This tool is piloted in the spindle of the machine so as to insure accurate bores. It is provided with a fly cutter *D*, which removes all scale and rough edges ahead of the inserted reamer blades in portion *E*. Tool *F* rounds the end of the coupling as the reaming step is completed. The collapsible tap used for cutting the threads is shown at *G*. In the illustration, an 8 1/4-inch coupling is being machined; on this size, the production averages ten couplings per hour.

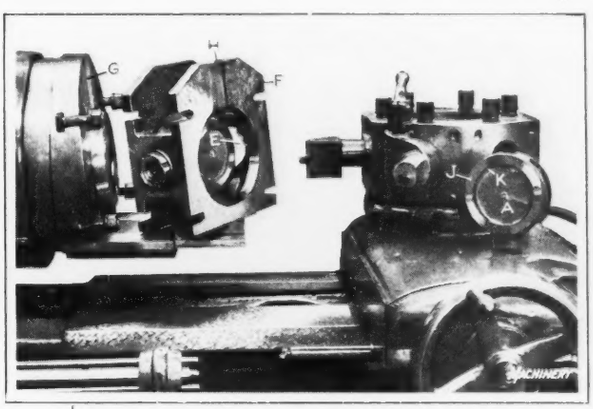

Fig. 3. Equipment provided on a Turret Lathe for machining Both Sides of Valve Gates at One Chucking

Machining Wedges for Gate Valves

The chuck and tooling equipment developed to facilitate the machining of both sides of a wedge-shaped part in one operation, are illustrated in Fig. 3. This wedge, which is shown upside down at *A*, fits into a gate-valve, and is raised and lowered to open and close the valve. On both sides of the wedge there is a slot, such as seen at *B* in Fig. 4. When the wedge is placed in the chuck, the slot on one side is slipped over block *C* to lock the wedge sidewise and longitudinally relative to the tools on the hexagon turret. It is located for height by resting on block *D*. Adjustable jaws *E* are clamped on the work opposite block *C* to hold the wedge securely in the chuck. Block *C* is adjustable to suit a run of castings.

All the chuck parts thus far mentioned are contained in housing *F*, which may be moved in and out on an extension of chuck part *G*, which is mounted on the spindle of the machine. While cuts are being taken, housing *F* is securely fastened to the face of part *G* by means of four bolts, but when one side of the wedge has been finished, these bolts are loosened and housing *F* is pulled forward on the extension of part *G*. The housing is next indexed 180 degrees on a heavy vertical stud mounted on the extension, then pushed back against the face of part *G*, and finally rebolted to this part. The opposite face of the wedge is now toward the turret, and can be conveniently machined. Each side of housing *F* is provided with a slotted steel insert *H* that engages a key on chuck part *G* to insure accurate settings.

The operation on each wedge face consists of finishing surface *J*, Fig. 3, with a square-nose tool, cutting a dovetail groove at *K*, rolling a brass seat into place in this groove, and finally, finishing the brass seat. All tools used in the operation are mounted

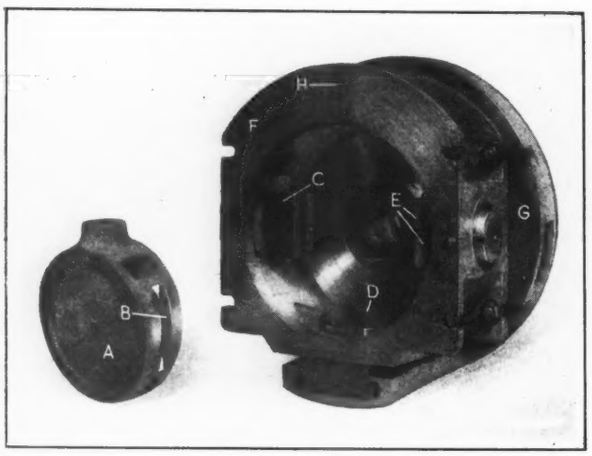

Fig. 4. Close-up View of the Chuck used on the Turret Lathe shown in Fig. 3 and One of the Castings machined

on the hexagon turret. The wedge is narrower at the bottom than at the top, the taper on each side being 5 degrees. Therefore, in order to place surface *J* in a true vertical plane for machining, the face of chuck part *G* is inclined at an angle of 10 degrees.

Equipment for Machining the Gate Valve

The wedge or gate finished in the operation just described is assembled into a valve that is machined to receive it by means of the equipment illustrated in Fig. 2. This is the same machine used in finishing the wedge, but it is provided with a different chuck and different tooling. Two seat rings *X* and *Y*, Fig. 5, are assembled into the valve, and the operation consists of machining the valve to receive these rings, and then facing the rings.

It will be seen from Fig. 2 that the chuck used in this operation is also of an indexing type, and consists of a part *A* mounted on the faceplate of the machine, and a housing *B* which can be indexed around a complete circle relative to part *A*. The valve is so held in the chuck that, as either end is indexed toward the hexagon turret, the various internal surfaces to be machined are brought into the desired planes relative to the tools. The tools are all mounted on the hexagon turret. The work is seated firmly in the chuck by screwing down the jaw on the side of housing *B* opposite the fixed block on which the work rests.

The first step in the operation consists of boring hole *C*, Fig. 5, and counterboring surface *D* in one side of the valve, by means of tools mounted on a boring-bar extended through the opposite hole *E*. In this step, hole *C* is first rough-bored, and then the tool is withdrawn the proper amount and fed sidewise for the counterboring, by means of the slide on which the boring-bar is mounted on the hexagon turret. In the next step, hole *C* is finish-bored. Threads are then cut in this hole to receive seat ring *X*, by means of a flat chaser held in a bar which is so constructed that only one pass of the tool is required to finish the threads. The boring tools and the chasing tool are mounted on successive sides of the turret. The correct lead of thread is obtained through the lead-screw of the machine.

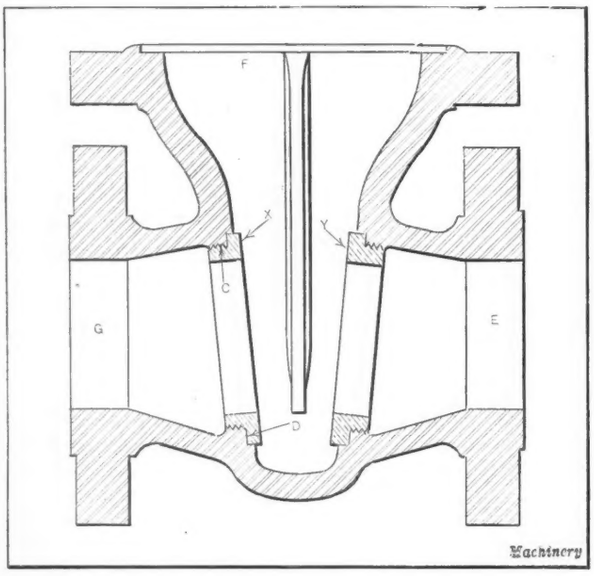

Fig. 5. Diagrammatic Illustration showing Gate Valve with Seat Rings in Place

Seat ring *X* is next screwed into place by advancing an adapter, mounted on the turret, into the valve through hole *E*, placing the ring on the adapter by hand through hole *F*, and then screwing the ring into place by again feeding the adapter forward. The fourth step consists of facing the seat ring and chamfering the corner along the periphery of the seat ring flange with tools held in a special bar that is also fed through hole *E*. At the end of this step, the chuck is indexed 170 degrees to permit finishing the valve to receive ring *Y*, screwing the ring into place, and facing the ring. All these steps are performed through hole *G* by the same procedure as was just outlined. For indexing part *B*, Fig. 2, a screw is loosened to release a locking screw, and after the chuck has been turned end for end, the swivel member is again locked securely in place.

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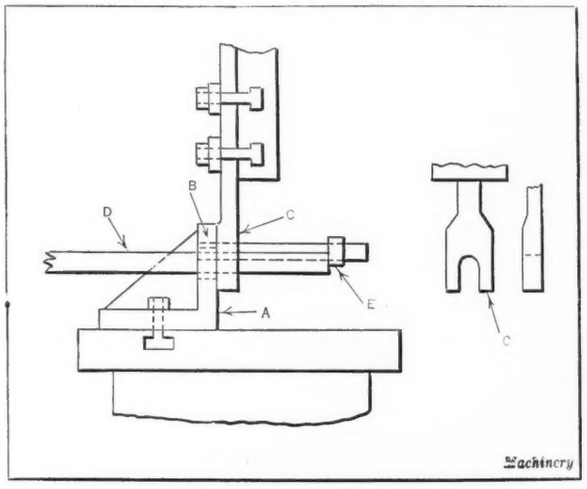
CUTTING OFF PINS ON A SLOTTER

By ROBERT RIMMER, Jr.

The job of cutting off a large number of cold-rolled steel pins, 3/8 inch in diameter by 2 inches long, from bar stock, was done economically on a slotter as follows: A heavy angle-plate *A* was bolted to the table, and fitted with a hardened and ground bushing *B* having an outside diameter of 3/4 inch and a hole which was a good sliding fit over the bar stock to be cut off. The bushing *B* was driven in flush with the face of the angle-plate, and the tool *C*, held in the toolblock of the slotter ram, was set in contact with the face of the bushing to shear off the pins. The bar stock *D* was fed in continuously from the back side of the angle-plate, the length of the pins cut off being controlled by the adjustable stop *E* mounted on stud screwed into the plate. Time as well as material was saved by cutting off the pins with the slotter equipment described, instead of employing the old method of cutting up the stock on a turret lathe.



Tools used on Slotter for cutting off Pins

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The exports of automobiles and trucks from the United States and Canada to other parts of the world during the first six months of 1926 exceeded all previous records, reaching a total of approximately 350,000.

Notes and Comment on Engineering Topics

We are informed that what is supposed to be the oldest rolling mill in the United States, located at Bridgewater, Mass., is being dismantled. This rolling mill was started in 1784, and was actively engaged in the manufacture of cannons during the War of 1812.

The radio compass, which constitutes one of the important commercial applications of the radio, is now used on a great many steamships. It was also used on the airship *Norge* on its trip across the North Pole to Alaska. The use of the instrument on that trip constitutes a most convincing proof of the value of the radio compass in aerial transportation.

A statement made by the Museum of Safety calls attention to the fact that through the efforts of well organized safety work, the hazards of railroad travel have been reduced about one-half during the period of ten years beginning 1914. Both the number of fatal accidents and the number of passengers injured, in proportion to locomotive-miles, have approximately been cut in two.

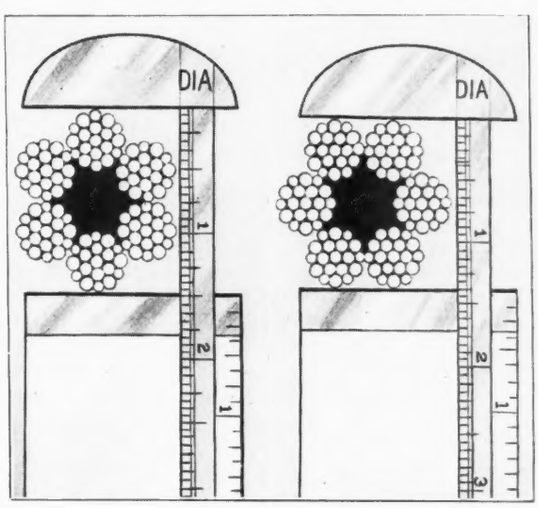
The present tonnage of merchant shipping under construction in the United Kingdom—840,000 tons—is the lowest on record since September, 1909, and is over a million tons below the average tonnage under construction during the year immediately preceding the war. On June 30, there were 200 ships under construction in the United Kingdom, of which 50 were oil engine ships, the tonnage of these ships being equal to 54 per cent of the steam tonnage under construction.

The tests recently made of the new three-engine Stout all-metal commercial airplanes mark another milepost in the development of successful commercial aerial navigation. The new Stout planes, built by the Stout All-metal Airplane Division of the Ford Motor Co., have three 200-horsepower engines. With eight men aboard and with a full supply of gas and oil, two engines, operating without the third, were able to make the plane climb, while when only one engine operated, the plane was able to choose landing fields within a radius of 45 miles, from a reasonable altitude. These planes are capable of carrying ten or twelve passengers in regular commercial service.

Electric lamps frosted on the inside instead of the outside, the latter being smooth as on clear bulbs, are now being manufactured successfully. The inside frosted lamp is far superior to the outside frosted lamp as far as light transmitting characteristics are concerned. Frosting the outside of the bulb is wasteful of light, offsetting, to some degree, the progress made in increasing the light producing efficiency of the filament. Also, outside frosted lamps collect dust and dirt quickly, which cannot easily be wiped off. The inside frosted lamp is only about 2 per cent less efficient than a clear lamp, whereas the loss of efficiency with the old-style outside frosting was three or four times as much.

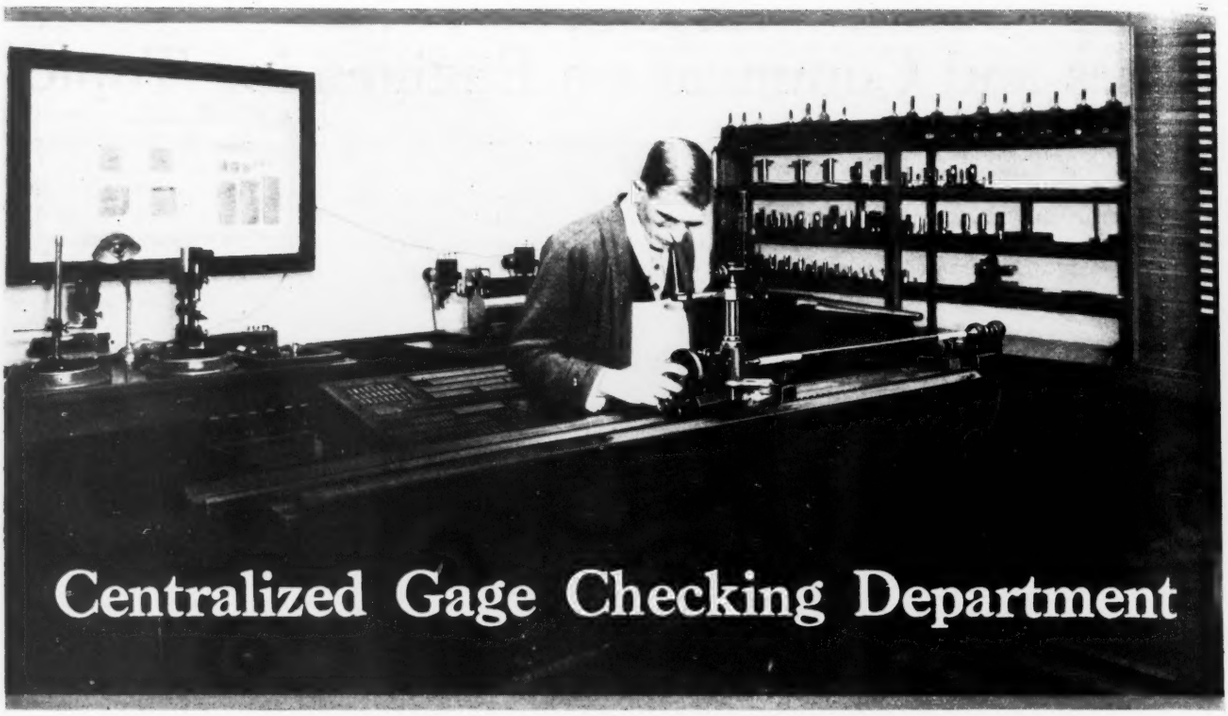
HOW TO MEASURE WIRE ROPE

There is only one correct way to measure wire rope, as shown in contrast to the incorrect method in the accompanying illustration. The American Cable Co. states that it is highly important that the proper size of rope be employed, since an under-sized rope will not give the degree of service that should reasonably be expected, while an over-sized rope represents needless investment. More important, however, is to have the rope and the sheave properly fitted. No wire rope should be allowed to travel over a sheave in which the groove is too small for the diameter of the rope. A pinching groove will do more damage to a wire rope in one hour than a properly sized groove in an entire week or more. Sheaves grooved 1/16 inch larger than the diameter of the rope will lengthen the life of the rope many times, as compared with rope life on pinching sheaves. Since sheaves are cheaper than good wire rope, there is small economy in continuing the operation of improperly grooved sheaves or drums. The diameter of drums or sheaves also greatly affects the life of wire rope. Whenever possible, large-diameter sheaves should be used, for the bending stresses are thereby reduced. Reverse bends should also be eliminated when possible, since reverse bending greatly diminishes rope service.



(Correct) (Incorrect)
Correct and Incorrect Method of measuring Wire Rope

Electric arc welding as a method of constructing locomotive tender tanks, instead of the customary riveting process, offers a prospect of a better product and reduced cost, according to results obtained by the Boston & Albany Railroad. In January, 1921, this road built at its West Springfield, Mass., shops a locomotive tender tank constructed throughout by arc welding equipment, with the exception of the safety appliances (grab handles). This tank was placed in service February 6, 1921. Since that time it has covered a distance of 201,563 miles without any defects having developed in the welding. With the arc welding method of construction, practically all laying out, punching, and drilling of sheets, angles, and T-braces, together with reaming, riveting, and calking, are eliminated. The Boston & Albany tank was made of 1/4-inch plate, with the following dimensions: 26 feet long, 10 feet wide and 5 feet 2 inches high. In the average tank of this capacity, there are approximately 7000 rivets, with a total weight of 800 pounds, and the number of holes punched in sheets, angles, and T-braces would total approximately 15,800. In the Boston & Albany tank there is a total of 1185 feet of welding, the welding rod consumed totalling approximately 398 pounds. In order to eliminate the water scoring and rusting prevalent in the riveted type of tank, the welding of T-braces to the bottom and top of the tank was continuous for its entire width. Experiments of this kind are of great value in determining the possible field for electric welding.



Centralized Gage Checking Department

System Employed to Insure Accurate Gages in a Large Plant which Uses More Than 20,000 Pin Gages Alone

By G. C. REILLEY, Supervisor of Tools and Gages, General Electric Co., Schenectady, N. Y.

SYSTEMATIC checking of gages is essential to successful interchangeable manufacture, because faulty work is sure to be the result if there is no system of periodic inspection to guard against the use of over-size or under-size gages. At the plant of the General Electric Co., Schenectady, N. Y., every gage in constant service is checked weekly, while gages used occasionally are checked each time that they are returned to the tool-crib even though they have been in use for only a few minutes. No gage is ever used longer than one week without being inspected. The size of this task of checking gages can be appreciated when it is understood that there are approximately 20,400 pin gages alone and about 12,400 snap gages. In addition to the gages in service, all new gages must be checked, and these are produced at the rate of about 4500 per year. On an average, 400 gages are checked each working day.

Special Department for Gage Checking

All gages are sent to one central department to be checked. In this department there is a "reference" room, measuring 20 by 25 feet, in which all reference gages are kept and all working gages are inspected. In an adjoining room, where a constant temperature of between 70 and 75 degrees F., is maintained, all master gages and accurate measuring equipment, are kept. Reference gages are compared with the masters in this room. This "standardizing" room measures 21 by 21 feet, and is located in the middle of a concrete building. The walls of the room are constructed of cement blocks, 18 inches thick, which prevent outside atmospheric conditions from affecting the room temperature. The heading illustration shows one end of the standardizing room.

Methods Used in the Reference Room

In the manufacture of turbines, many large parts up to 23 feet in diameter must be produced to the specified size, plus or minus 0.0005 inch. Obviously, gages of the snap type would not be practical for inspecting work of this size; the inspection is accomplished by means of steel tapes which are wrapped around the surface being checked. These tapes are 3/8 inch wide and 0.008 inch thick. The length of the tape must be equal to the circumference of a circle having a diameter equal to the diameter of the part to be checked plus the thickness of the tape. The limits allowed on the length of the tape for diameters up to 48 inches are plus or minus 0.00005 inch. For diameters above 48 inches, the limits allowed are plus or minus 0.0001 inch.

One particularly interesting job to which this method of inspection has been applied was the production of gears

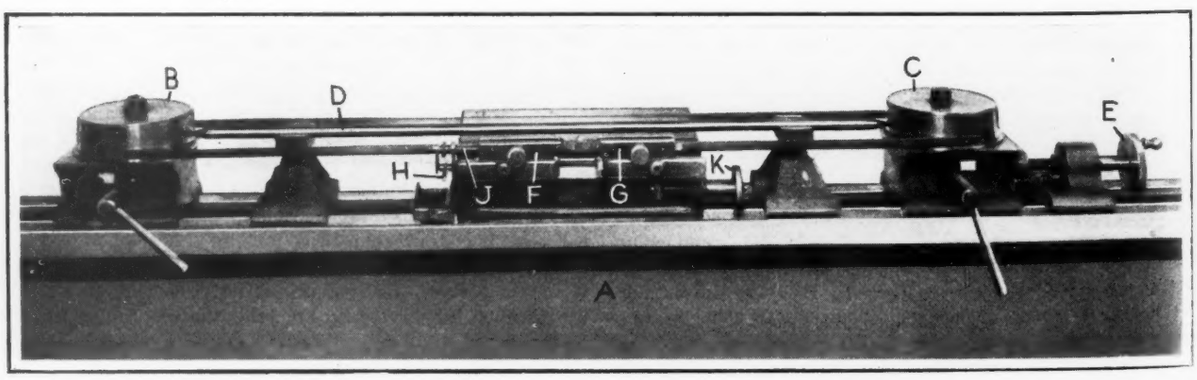


Fig. 1. Checking the Length of a Measuring Tape in a Machine of Special Design

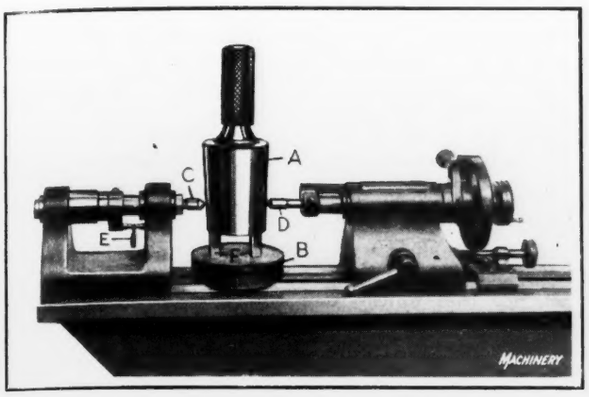


Fig. 2. Method employed in checking the Taper of Gages

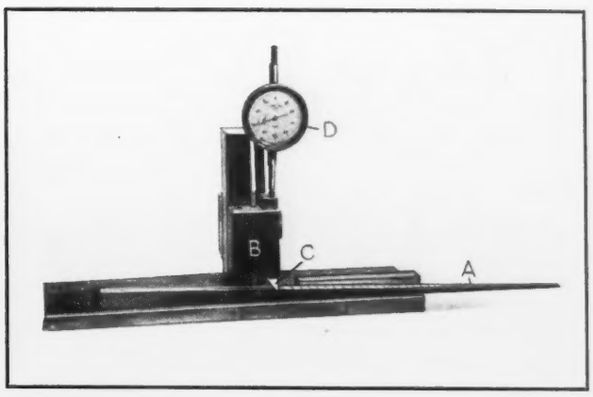


Fig. 3. Indicating Fixture used in scribing Air-gap Gages

having a pitch diameter of 72 inches for the U. S. Government. The teeth of these gears were formed with high-speed steel hobs, ground all over, and the specifications demanded that the accumulative error in the total periphery of the gear should not exceed 0.003 inch. As the gear had 288 teeth, the average permissible error in the circular pitch of the teeth was approximately one hundred-thousandth inch.

In order to check the tapes for length, it was necessary to build a special machine. This machine is shown in Fig. 1 with a comparatively short tape in place for checking. It will be seen that mounted on bed *A* are two slides which carry disks *B* and *C*. These disks are of known diameter, and in setting up the machine for a given job, the slide carrying disk *B* is clamped to the bed, and then the slide carrying disk *C* is moved along the bed until the opposite ends of pin gage *D* come in contact with the two disks. Close adjustments of disk *C* are made by revolving handle *E* of a micrometer screw. The slide carrying disk *C* is then also clamped to the bed.

With the machine set up as described, the tape is placed around the disks, and the two ends are gripped in clamps *F* and *G*, with a short portion of each end projecting beyond the clamps. The latter are mounted on a carriage that is also adjustable along the bed. At the beginning of a set-up, a small pin *H* is placed horizontally between two small jaws at the left-hand end of the carriage and held in that position by pressure exerted through spring *J*.

After the tape has been placed around the disks and the ends have been gripped, clamp *G* is moved slowly toward the other clamp by turning wheel *K* of a micrometer screw, thus drawing the tape tightly around the disks. When the tape is drawn tight, the tension of spring *J* is overcome, and pin *H* swings downward. At this moment the two ends of the tape should just touch and any amount of error in the length can be easily ascertained. In determining the length of pin gage to use for checking a given tape, use is made of a convenient formula. Bed *A* is of sufficient length to accommodate the longest tape used.

Checking Taper and Thread Gages

Gages are checked for the amount of taper in a measuring machine set up as illustrated in Fig. 2. At the beginning of an inspection, the small end of a gage, such as shown at *A*, is placed on base *B*. The top of this base floats, so that friction is eliminated in sliding a gage back and forth between the measuring balls of spindles *C* and *D*. With the gage in place on the base, spindle *D* is adjusted until pin *E* just drops from the horizontal position as the gage is passed between the measuring balls. Then the diameter of the gage in the plane of contact with the measuring balls can be readily determined from the vernier of the machine. Readings can be made to within 0.00005 inch.

Johansson gage-blocks of a convenient size are then placed on base *B*, as shown at *F*, after which the gage is mounted on the blocks. The diameter of the gage in the plane of the measuring points is then again determined in the same manner as before, after which the taper per inch or foot can be readily calculated.

The pitch diameter of thread gages is checked by the application of the three-wire system as illustrated in Fig. 4. Two wires are placed in threads on one side of the gage close enough together so that they may be covered by the anvil of the left-hand tailstock *A*. The third wire is placed in a thread on the opposite side of the gage directly in line with the adjustable spindle *B*. The gage is held vertically between centers in alignment with the anvil and adjustable spindle. Spindle *B* is next closely adjusted through wheel *C* until pin *D* drops from the horizontal position. The diameter over the wires is then obtained by observing the graduated dial and vernier of the machine, after which

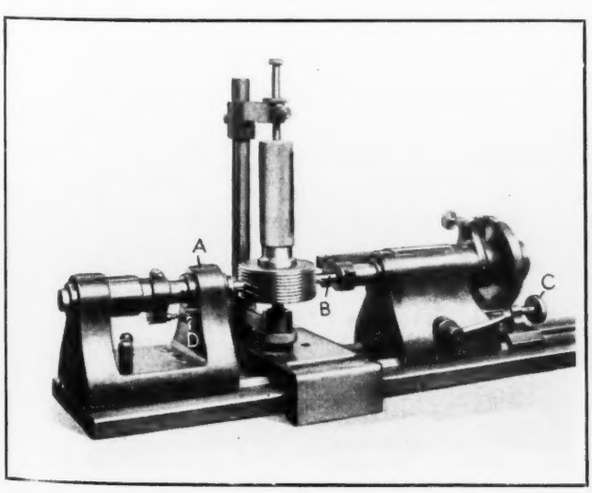


Fig. 4 Employing the Three-wire System for determining the Pitch Diameter of a Thread Gage

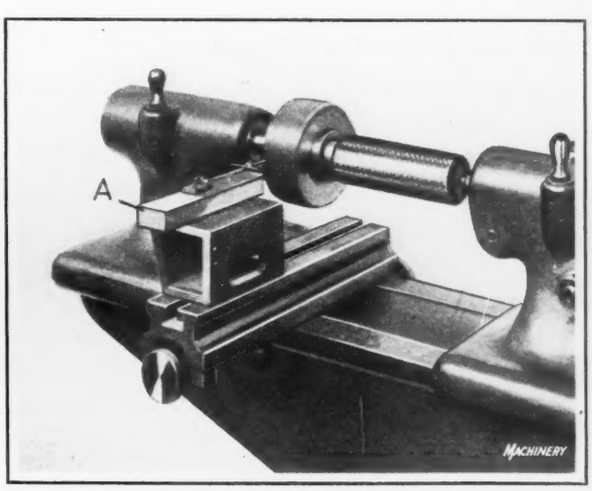


Fig. 5. Determining the Lead of a Thread Gage by Means of an Indicating Device

Fig. 6. Using the "Bi-ocular" for examining Defects in a Tap

the pitch diameter of the thread is determined by calculation. Thread gages are inspected for lead by means of the set-up shown in Fig. 5. With the gage held between centers and the feeler of indicating device *A* in contact with the sides of two threads, the gage is revolved. The movement of the indicating bar per revolution is registered within 0.0001 inch, and represents the lead of the thread.

Graduating Tapered Wedges

Long tapered wedges such as shown at *A* in Fig. 3 are employed in the shop to check the air gap or clearance between various parts. A typical case is the checking of the air gap between the rotor and poles of motors. These air-gap gages are about 15 inches long, and are graduated for every difference of 0.010 inch in thickness. Before the present method of graduating the gages was employed, it was necessary to grind the wedge very accurately as to the taper and then employ a micrometer for locating the points where the graduation lines should be scribed. With the present method, it is unnecessary to grind the taper within close limits, because the locations of the different lines are determined under an entirely different principle, which involves the use of the fixture shown in Fig. 3.

Housing *B* contains a dovetail slide *C*, the lower end of which rests on the tapered surface of the wedge. The spindle of indicator dial *D* rests on the upper end of the slide, with the result that any vertical movement of the slide is shown in thousandths of an inch by the indicator needle. In starting to graduate a wedge, a line is scribed close to the thin end, with this end projecting a sufficient amount to the right of slide *C* to locate the line at a predetermined thickness of the wedge. Each successive graduation line is scribed after sliding the wedge to the right, until indicator *D* registers an amount 0.010 inch greater than when the previous line was made. The scribing is performed with a fine-tooth saw blade, mounted in a convenient handle. Housing *B* may be adjusted on the post to suit work of various thicknesses.

Equipment of the Standardizing Room

In the heading illustration is shown an inspector engaged in checking a pin gage for length in an 80-inch Pratt & Whitney measuring machine. This machine is mounted on a concrete base which extends 4 feet into the ground to eliminate vibration. Readings are made on this machine to within 0.00005 inch.

Fig. 8 shows a Zeiss "Optimeter" arranged for checking the diameter of balls. There is a special holder *A* which is grooved to permit the ball to roll easily into place between two fingers *B* and directly beneath the spindle of the instrument. The diameter of the ball is then determined by adjusting the spindle and observing the reading in the microscope. Finally, lever *C* is manipulated to swing fingers *B* around and tilt them downward so that the ball can roll off the holder. The "Optimeter" is used extensively for checking the diameter of plug gages and for similar common inspections.

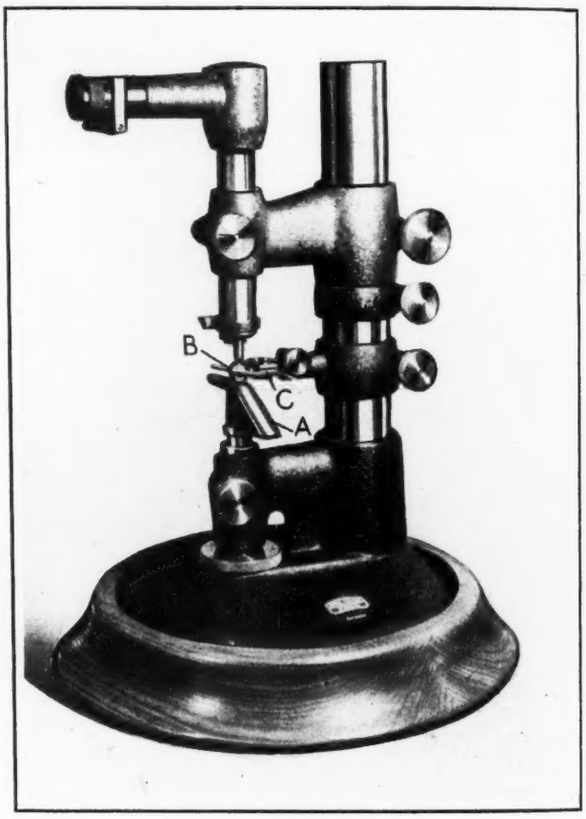


Fig. 8. "Optimeter" set up for determining the Diameter of Balls

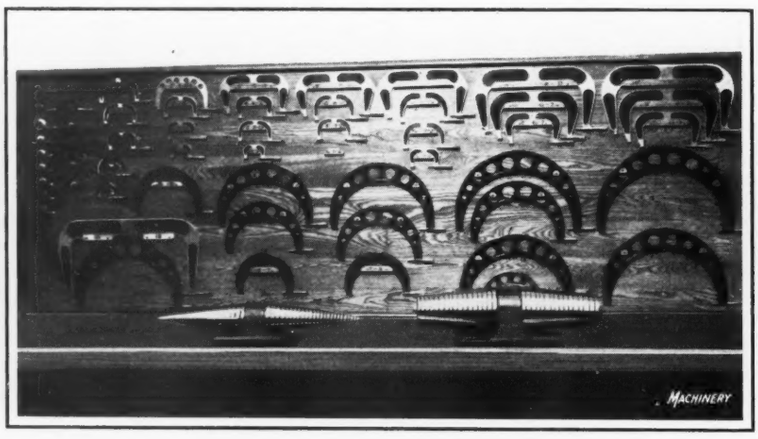


Fig. 7. Micrometer Board and Bench running along One Wall of the Standardizing Room

Water checks or other defects in gages, drills, reamers, taps, etc., are closely observed through an Ernst Leitz "Bi-ocular." The thread form of various tools and gages may also be observed, as illustrated in Fig. 6. This device magnifies fifteen times. Another instrument employed in checking tools is a Zeiss optical twist drill gage, which shows whether or not the point is located centrally on a drill. Van Keuren light-wave equipment is used for checking the parallelism of surfaces, while thread forms are checked with a Jones & Lamson thread comparator.

Fig. 7 shows a board extending along one wall of the room, on which micrometers are arranged. The largest of these micrometers measures work from 18 to 19 inches in diameter or thickness. On the bench in front of the board there are two stands of hardened and ground disks which are used in checking micrometers and snap gages. The disks of one stand range from 1/2 to 3 15/16 inches in diameter, and those of the other, from 4 to 6 inches in diameter. There is a disk for every difference of 1/16 inch between 1/2 and 6 inches. Johansson gage-blocks, of which there are five sets, are the measuring standards to which all gages are made. These blocks have been verified by the U. S. Bureau of Standards as accurate within one hundred-thousandth inch.

* * *

WEAR RESISTANCE OF CARBURIZED STEEL AND MANGANESE STEEL

In a paper read before the eighth annual convention of the American Society for Steel Treating at Chicago in the latter part of September, W. J. Merten, metallurgical engineer connected with the material and process engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., described experiments made to determine the comparative wear resistance of 14 per cent manganese cast steel and casehardened steel, when subjected to relatively high pressure in sliding motion, free from shock or pounding.

The conclusions that may be drawn from the experiments made are that high manganese steel, when subjected to heavy pressure in sliding motion, compares unfavorably with casehardened steel. The variation in Brinell hardness has little, if any, influence upon its resistance to abrasion when under steady pressure and sliding motion without shock. There is one factor, however, in favor of manganese steel under these conditions, namely, that its entire sectional area has practically the same wear resistance, while the depth of the wear-resisting case in casehardened steel is rarely more than 3/32 to 1/8 inch.

It should be emphasized that the experiments dealt only with the uses of the two steels when subjected to heavy pressure in sliding motion without shock, and they have no bearing upon the value of high manganese steel for other service applications where pounding, shocks, or crushing are encountered. The value of manganese steel for such services is not questioned.

The value of carburized steel for high pressures in sliding motion free from shocks has been established, however, both for low carbon and medium carbon steels. The favorable results from casehardened steels depend largely upon the care exercised in the carburizing and heat-treatment of the steel, and results such as obtained in the tests referred to can be expected only from a properly conducted process of carburization and heat-treatment.

* * *

SAFETY OF AIR TRAVEL

It is now possible to travel by airplane from Malmo in Sweden to Dakar in western Africa—a distance of 3600 miles—in 4 1/2 days without lengthy stopovers. The regular air routes between Sweden and the continent of Europe, employing Swedish-built airplanes, transported last year 20,000 people without a single mishap resulting in either loss of life or serious injury to the machine. The planes used are provided with three motors and carry ten passengers, besides two pilots and a mechanic. It is stated that no emergency landings have been required during the entire year and that the service has been as regular as that of a steamship line.

THE A. S. M. E. ELECTS OFFICERS

The American Society of Mechanical Engineers has elected Charles M. Schwab president of the society for the coming year. The record of Mr. Schwab's life is almost too well known to require detailed review. He was born at Williamsburg, Pa., February 18, 1862. He entered the steel business as a stake driver at the Edgar Thompson Steel Works, where he later served as chief engineer and assistant manager. In 1887 he was made superintendent of the Homestead Steel Works, and from 1889 to 1897 he was general superintendent of the Edgar Thompson Works. In 1897 he was made president of the Carnegie Steel Co., and from 1901 to 1903 he was president of the United States Steel Corporation, which was founded in 1901. He is now chairman of the board of directors of the Bethlehem Steel Corporation, the Bethlehem Steel Co., and the Chicago Pneumatic Tool Co. He is also a director in a great many other industrial and commercial enterprises.

During the war Mr. Schwab acted as director general of shipbuilding on the United States Shipping Board. In December, 1918, he was elected an honorary member of the American Society of Mechanical Engineers. On that occasion, Mr. Schwab made a statement highly characteristic of the man: "It is not the great public reputation that brings satisfaction to the human heart of a man who is worth while, but it is the acclaim and approval of the people who have known him and have known what he has done, and there is no honor that I have ever received and there is no acclaim to which my ears have ever listened, that bring me a deeper sense of real satisfaction and pleasure than the approval of this great engineering society of the United States."

Charles M. Schwab,
Newly Elected President of the American Society of Mechanical Engineers

Mr. Schwab has earned a reputation for the skill with which he handles men and the close contacts which he maintains with those working for him—characteristics that have gained the admiration and respect not only of his own associates, but also of the public at large.

Mr. Schwab will formally assume his new office as president of the American Society of Mechanical Engineers at the annual meeting of the society in New York early in December, at which time he will succeed William L. Abbott of Chicago. Mr. Schwab has accepted this new responsibility with his characteristic enthusiasm, and it is certain that his organizing power and personality will greatly aid in promoting the purposes for which the organization of mechanical engineers stands.

Three vice-presidents, three members of the council known as managers, and a treasurer were also elected. The vice-presidents are Charles L. Newcomb, manager of the Deane Works of the Worthington Pump & Machinery Corporation at Holyoke, Mass.; Everett O. Eastwood, professor of mechanical engineering at the University of Washington, Seattle, Wash.; and Edwards R. Fish, vice-president of the Heine Boiler Co., St. Louis, Mo. The three new members of the council, known as managers, are Colonel Paul Doty, chairman of the Minnesota State Board of Registration for Architects, Engineers, and Land Surveyors, St. Paul, Minn.; Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt.; and Conrad A. Lauer, treasurer and general manager of Day & Zimmermann, Inc., Philadelphia, Pa. Erik Oberg, editor of MACHINERY, New York City, was re-elected treasurer of the society.

* * *

The use of a light cutting oil when machining with diamond tools increases the life of the diamond from two to three times according to a statement made by O. C. Kavle of the Manufacturers' Consulting Engineers, Syracuse, N. Y., at a production meeting of the Society of Automotive Engineers.

Suggested Improvements in Machine Tools

At the Machine Tool Session of the Production Meeting of the Society of Automotive Engineers, held in Chicago in connection with the National Steel and Machine Tool Exposition during the latter part of September, E. R. Stoddard of the Studebaker Corporation, read a paper entitled "What Goes Wrong with Machine Tools in Automobile Production?" In this paper, the author stated that inasmuch as automobile production is carried on mostly on a piece-work basis, machine tools of very rugged construction are required. He also pointed out some of the causes of failure, as observed by himself, and made recommendations which he believed would help to reduce the number of failures. The following paragraphs contain an abstract of the statements made by Mr. Stoddard in his paper.

A Shut-down of the Production Line in an Automotive Plant is Very Costly

The failure of machine tools in the production line is a very serious and costly affair. It means that not only the particular machine that fails is out of production, but the entire line doing previous and subsequent operations must generally be stopped until repairs are made, making the total loss of production very great and expensive. Assume, for example, that the production in a plant is 400 cars per day of a type yielding a net profit per car of $100. A breakdown that holds up the assembling line would bring about a direct cash loss to the company of something like $4000 an hour while repairs were being made. The stock of finished parts on hand usually permits the assembling department to go ahead while the emergency lasts, but sometimes there is not sufficient stock ahead of some one component part needed in the assembly.

What are the Most Common Causes of Machine Tool Troubles?

In order to determine intelligently what goes wrong with machine tools, the Studebaker plant at South Bend investigated the subject by asking for answers to the question "What is the direct cause of most failures?" This question was put to the men directly in charge of maintenance during the last seven years. From the various reports obtained in this manner, the following may be considered the main causes of machine tool troubles. The importance of each difficulty is indicated by the order in which it is listed.

1. Lack of lubrication.
2. Overloading and carelessness.
3. Poor design or construction of machine tools.

Eliminating Shut-downs Due to Lack of Lubrication

Machine tool builders could greatly reduce the number of failures of machine tools in automotive plants by providing positive force-feed lubrication to all high-speed moving parts; by providing manifold oilers with sight feed; by bringing copper tubes from one or more central points to the parts to be oiled, for oiling with can or squirt gun; by providing all oil-cups with a trap or guard which prevents chips or other foreign matter from getting into the bearings; and by providing self-oiling loose pulleys of liberal size on machines driven directly from the lineshaft, so that these pulleys may be capable of running twenty-four hours without attention.

Referring to the points mentioned, it should be emphasized that many lubrication failures are due to the fact that oil-holes are scattered all over the machine, and therefore considerable time and attention are required to properly oil it. When the operator is on piece-work, he does not give the machine the attention it should have. Some parts are not oiled, because the oil-hole becomes covered with chips, grease, or other foreign matter, and the operator does not know that there is an oil-hole to be filled. For this reason, manifold oilers are of great importance. At the Studebaker plant, the company has provided manifold oiling systems on many machines that have been supplied by the manufacturer with individual oil-holes for every bearing. The discussion after the paper among the automotive equipment engineers present brought out that in one case a machine supplied to an automotive manufacturer had over fifty individual oil-holes that the operator was supposed to fill with oil.

Referring to the need for liberal-sized self-oiling loose pulleys, the author of the paper mentioned that only recently five new machine tools with countershafts were installed in the plant, the loose pulleys of which carried 5-inch belts and ran at a speed of 500 revolutions per minute. The oil-cups supplied with the pulley were entirely too small, and after a two-hour run, the countershaft was taken down, and the pulley bushed and provided with a proper oiler.

Failures Due to Overloading, Dull Tools and Carelessness

Production foremen and operators can greatly reduce the number of machine tool failures by seeing to it that all work is securely fastened or clamped in jigs or fixtures before starting the cut; by keeping the machines free from chips to prevent jamming; by keeping the cutting tools sharp at all times; by removing from the machines, before any damage has been done, castings or forgings that are too hard or that have an excessive amount of stock to be machined off; by keeping the machine tools well oiled at all times; and by keeping wrenches, bolts, clamps, or other loose pieces off the machine, as these might fall into the moving parts, due to vibration.

Operating Difficulties Due to Poor Design or Construction

Machine tool designers can greatly aid in reducing machine tool failures in automotive plants, thereby cutting down the number of lost productive hours, by providing interlocking handles or clutches so that an inexperienced operator cannot damage the machine by locking moving parts when the power is on; by providing shear pins to prevent an excessive load from being placed on the machine from any cause; by designing the machine so that it will free itself easily from chips; and especially by protecting the ways, lead-screws, gears and other moving parts from chips.

Referring to the need for interlocking devices, the author mentioned that there are at the Studebaker plant two two-stage slab milling machines with one bank of cutters for roughing and one bank for finishing; each bank is independently motor-driven, and the table feed is geared to the roughing head. In one instance, the operator placed work in his fixtures and started the machine, but failed to start the motor driving the finishing bank of cutters. The result was that the cylinder blocks, after having been rough-milled, were forced through the stationary bank of finishing cutters, which caused costly damage both to the cutters and the machine.

Summarizing his impressions, Mr. Stoddard stated that the responsibility of keeping machine tools running continuously in automotive plants is a joint one, to be shared by the machine tool manufacturer, the machine tool designer, the foreman of the department in which a particular machine tool is used, and the operator in charge of the particular machine. Having for many years been closely connected with the maintenance of machine tools in automotive plants, the author stated as his belief that if it were possible to obtain thorough cooperation between the four factors mentioned, there would be very few machine tool failures in automotive production.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, October 15

THE position of the metal-working industries in this country still continues, of course, to be dominated by the coal strike. An unusual feature of the situation is that unemployment (exclusive of miners) has shown a steady decrease throughout the month, the decrease being at the rate of 10,000 to 20,000 per week, so that there are now approximately 50,000 fewer unemployed than at the beginning of September.

Some Improvement is Reported in the General Engineering Field

Reports from different parts of the country are conflicting. Even those from the same district often seem contradictory. There are, however, important underlying features on which the general position of the industry can be based. These are as follows: During the early part of the month foreign coal enabled a number of manufacturers to start activities. Later, however, the foreign coal was found generally to be unsatisfactory, and toward the middle of the month a slackening of business was experienced. The steady return to work of the miners has released a certain amount of coal for important industrial undertakings, with the consequence that at the end of the month an improvement is again reported.

The Sheffield Chamber of Commerce remarks on the extraordinary vitality of industrial Sheffield in the face of the strangling effects of the coal shortage. The heavy trades are naturally badly affected in all districts, for they require a large quantity of coal for unit of output, but the light and medium industries continue to maintain a certain degree of activity, and there are very few instances of urgent contracts or orders having been neglected. Experience throughout the country has been that although not many very large orders have been placed, a great volume of inquiries is being dealt with, and a tremendous number of orders is anticipated the moment the coal stoppage ceases.

Railway engineers have not yet been seriously affected by the shortage of steel, and continue to be well employed. Australia, India, South Africa, and South America are all in the market for further supplies. Electrical engineers are busy, on the whole, but output is retarded through shortage of raw materials.

The Machine Tool Industry Remains Quiet

The machine tool industry is naturally not so flourishing as could be wished. The largest customers of machine tool manufacturers are in most cases severely handicapped by the shortage of fuel and metals. A few makers, however, report that those customers who have financial reserves and a reasonably optimistic outlook are wisely taking advantage of the lull to prepare for the anticipated boom by bringing their equipment into line with high-production requirements. Orders for small tools are naturally not abundant, but there are enough to keep most firms working steadily.

The Automobile Industry is Preparing for the Coming Exhibit

The automobile industry is naturally excited and hopeful about the forthcoming motor show. An outstanding feature of the year's progress in design is the number of firms who will be exhibiting six-cylinder cars of 14 to 20 horsepower, selling at prices ranging from £350 to £500. This six-cylinder market is one that has not yet been tapped by British manufacturers, and it is hoped that the new models will compete successfully with the large numbers of six-cylinder American cars that are being sold at about the same prices. The lower horsepower of the English cars would certainly augur well for their success in view of the present taxation system of £1 per horsepower. The automobile industry has flourished exceedingly for some years, and there is every reason to think that, provided the present industrial dispute is settled quickly, there will be no impedance to its progress.

The Shipbuilding Industry Reports High Output

Were it not for the shortage of steel, the shipbuilding industry would be more flourishing than it has been for many years; indeed, the Clyde output for August was higher than that of any other month for some years. A large number of orders have been placed with British concerns for new tonnage, including five 14,000-ton steamers and 20,000-ton motor ships. Other orders will undoubtedly be placed as soon as the industrial horizon is cleared. Oil-fuel ships continue to form a large proportion of the new tonnage.

Exports Show Decline Due to Coal Shortage

The decline of about seven millions in the exports of British manufactures during the month of August, as compared with July, is an unpleasant but perhaps salutary reminder of the serious economic consequence that must inevitably attend the stoppage of coal mining. The use of imported fuel and the increased consumption of foreign iron and steel have helped materially to maintain production on orders previously booked, and orders of considerable value are still being placed with British firms for export markets.

As regards the machine tool exports of August, the last month for which figures are available, the weight of exports decreased by about 170 tons, while the value dropped about £4000. The total weight of machine tools exported during August was 1268 tons, of which the value was £147,675. The chief increases in the various sections of machine tools were drilling and milling machines, presses, and punching and shearing machines. Grinding machines, planers, and shapers suffered a setback. The value of small tools and cutters exported during August was £56,210, a drop of 25 per cent, as compared with the July figures, but a rise of about 15 per cent over the June figures. As a summary, it may be stated that the export tonnage of machine tools was slightly over the average of the current year, while the ton value rose ten points.

As the figures for eight months of the year are now on record, they afford some indication as to how the year is likely to turn out. The promise is that the export trade will be slightly better than 1925 or the average for the years 1921-1924 in tonnage, and tonnage is still the best basis of comparison. Exports on this basis are now 95 per cent of the pre-war standard. The rise in imported tonnage has been for about twelve months double the average of pre-war standard, and double the years 1921-1924, with a considerable fall in ton-value.

At present the tendency of machine tool exports, and indeed, engineering exports generally, varies from stationary to an upward trend, with an expectation of a considerable increase—contrary to the general tendency of trade, which is somewhat backward.

It is reported that many orders will be placed for machine tools from New Zealand Government Railways. Considerable orders continue to be received from over-seas, particularly for heavy electrical, railway, and structural work.

Extensive preparations are being made for the British Industries Fair, which will again be held in two sections, in London and Birmingham. The schedule for the Birmingham section covers all the engineering exhibits. The Sheffield trades and electrical industries will have extensive exhibits this year.

Current Editorial Comment

in the Machine-building and Kindred Industries

THE ADVANCE OF THE POWER PRESS

Many parts formerly made from castings, parts produced from forgings which require intricate machining work and many articles formerly spun from sheet metal, are now produced faster, better and more economically in the power press. As compared with castings, additional strength, lighter weight and reduction in cost are gained. As compared with forgings and spun shapes, reduced cost is the important consideration.

We recently saw an automatic power press producing brass caps from No. 30 gage strip brass at the rate of over 9000 an hour. Another press produced seamless drinking cups at the rate of over 2100 per hour, drawing four cups at a time. Still another press was observed cutting washers from strips of rolled steel, 1/16 inch thick, at the rate of 540 washers per minute.

The new steels especially adapted for making punches and dies have increased the life of these tools to an almost unbelievable degree. The number of pieces blanked between sharpenings depends upon the material being cut, but it may be anywhere from 15,000 to 100,000, and the total life of the die, in many instances, is reckoned in millions of parts.

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ART IN MACHINE DESIGN

The old proverb "Clothes make the man" applies to some extent to machines as well. They must, of course, function correctly and perform the service for which they are built; but in addition their general appearance must inspire confidence in the care taken in their design and construction. A crude appearance is likely to make a prospective buyer suspect a similar crudeness in the mechanical design.

At a recent meeting of the American Society of Mechanical Engineers, Dean Kimball of Cornell University, read a paper on "Decoration and Proportion in Machines" which aroused keen interest among those present. By illustrating steam engines, locomotives, automobiles and machine tools in the earliest stages of their development and as they appear at present, he showed that the design of a machine generally passes through three different stages of development, reaching in the third stage a form in which it has been consistently and carefully worked out to harmonize with its purpose.

In the first and earliest stage of the development of any machine, utility alone is the main consideration. The early machine tools, steam engines and locomotives were crude in appearance, but they performed their functions as well as was expected in those days.

The second stage was the decorative stage, when in order to improve upon the appearance of the machine, the designer turned to decorative designs of various kinds, sometimes borrowing artistic ideas from fields wholly foreign to the purpose of the machine or object being made. Early steam engines and machine tools were often built with fluted Grecian columns. Architectural designs of different kinds were, in fact, quite common in the machines built during the early and middle part of the nineteenth century. Having no reference to the purpose of the machines, these decorations gradually disappeared. During the last twenty-five years, especially, designs have been developed along lines determined by the actual purpose for which the machine is intended; at the same time, the machine designer has developed a certain artistic conception of what constitutes a pleasing appearance.

It is important to study the action of the mechanism of a new machine so that it will function correctly; but it is almost equally important that the appearance of the machine give evidence of careful thought, because buyers now have become so accustomed to well proportioned machines that they are prejudiced against one that does not present a symmetrical and pleasing appearance.

* * *

AMERICAN TOOLS COPIED IN GERMANY

Information obtained from Germany indicates that many American machine tools are now being copied by German builders, some of them without any change whatever; some with slight modifications. Many of these machines are frankly sold as copies, the name of the American maker of the original being mentioned in advertising it and sometimes stamped directly on the machine with the word "type" or "system" added. In one instance, exact copies of a machine designed and built by a well-known American manufacturer have been imported and sold in the United States.

American machine tool manufacturers are taking cognizance of these conditions because of the extent to which this copying is being carried. There has always been a certain amount of copying of American designs abroad, but at present the extent to which it is being carried surpasses anything in the past. Copies of over sixty American machine tools built by fifty different American makers are available in the German market, and in several instances more than one firm has copied and placed on the market the same machine. We are told that at a recent machine tool exhibit in Germany, copies made by four different German builders of the same American machine were shown.

American machine tool builders are taking note of this condition, and where patents have been obtained in Germany, the situation is comparatively simple. In one case the German courts have already upheld the patents of the American machine tool builder and awarded damages. Similar action is likely to be taken shortly in a number of other instances as American machine tool builders are thoroughly aroused to the seriousness of the situation, especially when these copied machines are sold in the American market.

We are friendly to the German people and wish them success; but such methods will not help them to accomplish it.

* * *

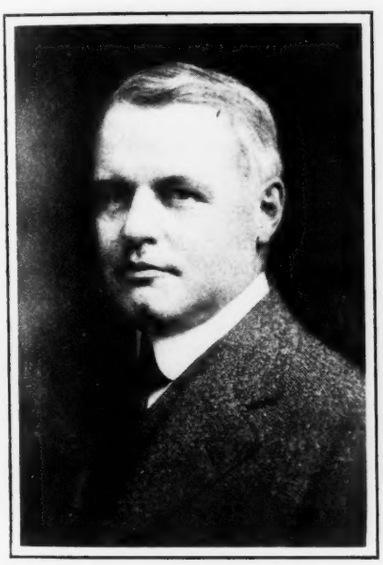
CENTRALIZING TOOL GRINDING

In many shops where the machine tools are comparatively up-to-date and in good condition, the milling cutters, drills, counterbores and other cutting tools are not always kept up by careful grinding or sharpening, and the machines have no opportunity to produce to their full capacity. The sharpening of the cutting tools is left to the machine operator, or to one or two men who grind all the tools for one department. Proper inspection of the reground tools is seldom possible under these conditions.

To remedy this condition, in some plants a centralized department for grinding all tools used has been established. Here the men doing this work become specialists on different kinds of tools, and an inspector is employed who examines every tool before it leaves the department. As a result the productive capacity of high-class machine tools has been increased to a very considerable extent. One large automobile plant employing this method states that the extra cost of maintaining a special tool grinding department is recovered many times over by the additional production obtained from machines that are provided at all times with properly ground tools.

National Machine Tool Builders' Meeting

THE twenty-fifth annual convention of the National Machine Tool Builders' Association held at Lenox, Mass., October 4, 5, and 6, was unusually well attended, and a great deal of interest was evidenced in the discussions of the various topics brought before the convention. Among the reports of the committees, the one by the exposition committee received marked attention. As has already been announced, the National Machine Tool Builders' Association will hold a machine tool exposition in Cleveland during the week beginning September 19, 1927. In his report, the chairman of the exposition committee, J. Wallace Carrel of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, reviewed what has been done up to the present time in connection with the exposition. About 40,000 square feet of space has already been engaged by member companies. The building engaged for the exposition has an effective space area of 67,000 square feet.



James E. Gleason,
Newly Elected President of the Association

P. E. Bliss,
elected First Vice-president of the Association

Wilson P. Hunt,
elected Second Vice-president of the Association

Standards Committee Recommends Definite Fields of Activity

The standards committee, of which A. L. Stewart of the Gleason Works, Rochester, N. Y., is chairman, made a report outlining the functions of the standardization work to be undertaken by the association. These functions were formulated under three headings, as follows:

1. To undertake and initiate projects of standardization that are mainly internal to the industry, and have little or no user interest.
2. To suggest projects of standardization that have a considerable user interest, and that can be handled through the regular machinery provided by the American Engineering Standards Committee.
3. To promote the use within the industry of national standards as approved by the American Engineering Standards Committee, and also all such other industry standards as may be worked out specifically for machine tool builders.

Association Advertising—Museum of Peaceful Arts

The advertising committee, of which Frederick B. Heitkamp of the Cincinnati Milling Machine Co., Cincinnati, Ohio, is chairman, presented a report outlining what has been done to obtain publicity for the association during the past year. The usual reports were also submitted by the officers of the association.

At one of the sessions, Professor J. W. Roe of New York University addressed the association on the subject "Plan for Organization of the Machine Tool Section of the Museum of Peaceful Arts," in which he outlined the ideas that have been worked out for an educational and instructive permanent exhibition of machinery, tools, and equipment, in the museum planned for this purpose in New York under the will of the late Henry R. Towne.

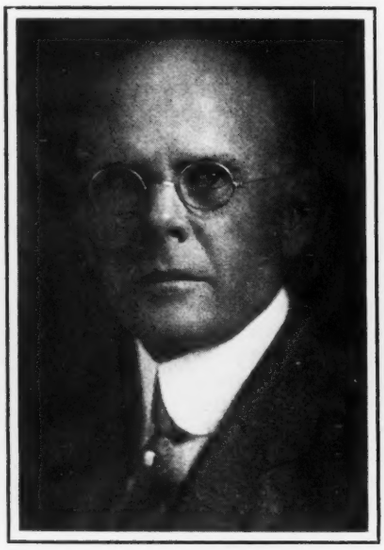
Among other subjects discussed at the convention were apprenticeships and the training of men in engineering and management to enter into the machine tool industry; foreign competition, with special reference to the copying of American machine tool designs in Germany; the collection of wage statistics pertaining to the machine tool industry; and standard classification or indexes covering the machine tool field.

President's Address and General Manager's Report

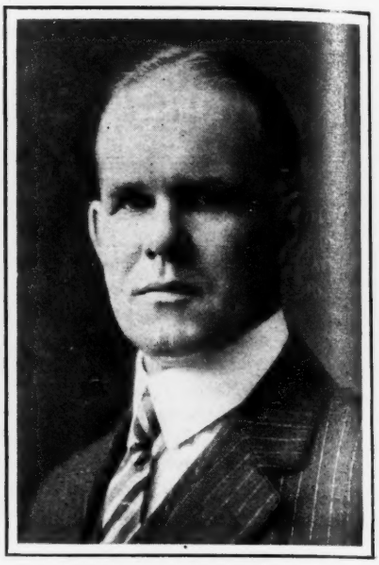
The president of the association, H. M. Lucas, president of the Lucas Machine Tool Co., Cleveland, Ohio, reviewed the past and present activities of the association in a comprehensive address, quoted at length on page 181 of this number of MACHINERY.

In his report to the association, Ernest F. DuBrul, its general manager, called attention to the progress of the standardization work, mentioning that the T-slot standardization committee had just completed its work and that other committees were making good progress. He briefly reviewed the present business situation, stating that early this year conditions were apparently shaping very strongly for a boom, which would, of course, have been followed by a recession. Many business forecasters assumed that most business men would lose their caution this year, as they had in past years under similar conditions. But this year, business men heeded the forecasters' storm signals to such an extent as to nullify the forecasts in great measure. So far as the forecasters produced a cautious state of mind in business men, they did a great service to business. No one need now be classed as a pessimist for believing that a high rate of activity is not likely to be maintained indefinitely. Some

E. A. Muller, Treasurer



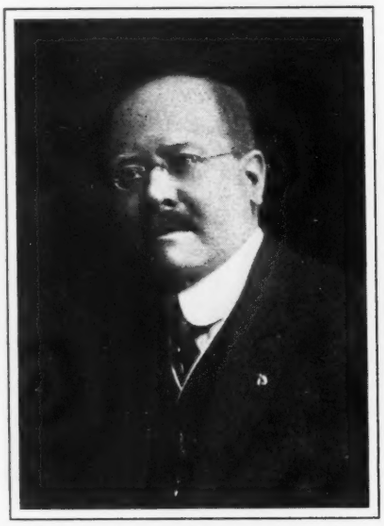
Herbert L. Flather, Director



Henry K. Spencer, Director

change in condition will take place some time, and it is well to be prepared to recognize that change whenever it comes.

"It is reasonable to assume," said Mr. DuBrul, "that business fluctuations will become less violent in the future than they have been in the past. Violent fluctuations of the past have been due largely to lack of reliable information on which to base sane judgment, but the depression of 1921 set many thoughtful business executives to studying these wasteful fluctuations."



A. H. Tuechter, Newly Elected Director

The Importance of Patent Protection

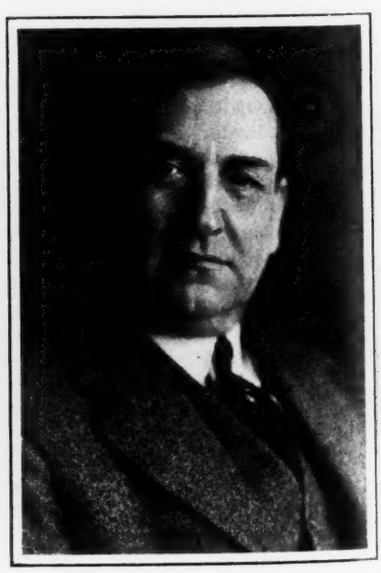
Mr. DuBrul pointed out the necessity for protecting one's intellectual property in inventions by taking out patents that are really worth while, on devices that are really patentable. He pointed out how an incompetent patent attorney may draw poor claims that will not give all the protection that the law permits. "Machine tools," said Mr. DuBrul, "certainly offer a fertile field for the exercise of invention. As shown by the developments of recent years, they have produced some very new and extremely useful results in saving time and increasing production, as well as improving the quality of the product. These improvements should be, and are, subjects of good patents that will protect the inventor if he or his attorney know how to draw a good claim." The importance of foreign patents, to protect American inventions abroad, was also discussed during the course of the meeting.

Election of Officers

At the meeting the following officers were elected for the coming year: James E. Gleason, Gleason Works, Rochester, N. Y., president; P. E. Bliss, Warner & Swasey Co., Cleveland, Ohio, first vice-president; W. P. Hunt, Moline Tool Co., Moline, Ill., second vice-president; and E. A. Muller, King Machine Tool Co., Cincinnati, Ohio, treasurer. Henry Buker, Brown & Sharpe Mfg. Co., Providence, R. I.; Charles C. Swift, Ohio Machine Tool Co., Kenton, Ohio; and A. H. Tuechter, Cincinnati Bickford Tool Co., Cincinnati, Ohio, were elected directors. Herbert L. Flather, The Flather Co., Nashua, N. H., and Henry K. Spencer, Blanchard Machine Co., Cambridge, Mass., continue in office as directors. Ernest F. DuBrul is general manager of the association.

Henry Buker, Newly Elected Director

Charles C. Swift, Newly Elected Director



Ernest F. DuBrul, General Manager

Problems of the Machine Tool Industry

Abstract of Address by H. M. LUCAS, Past President of the National Machine Tool Builders' Association, President, Lucas Machine Tool Co., Cleveland, Ohio

IN his address before the annual convention of the National Machine Tool Builders' Association at Lenox, Mass., October 4, H. M. Lucas, president of the association during the past year, reviewed the history and present activities of the association. He called attention to the fact that the standardization work of the association was not a new idea, but had been referred to as early as 1903, when Mr. Lodge, then president, advocated the adoption of standards that would facilitate interchangeability of faceplates, chucks, and tools from one machine to another, irrespective of the make of the machine. "In 1903," said Mr. Lucas, "it took a bold man indeed to propose such standardization. In 1926, only a very stubborn man would try to resist the demand for standardization. It takes no great prophet to say that in the next five years we shall be very far ahead of where we now are in that matter." During his address, Mr. Lucas dealt with many subjects, including apprenticeships, the code of ethics, the coming machine tool builders' exposition, and the general status of the industry. The following paragraphs are quoted from his address:

H. M. Lucas,
President of the National Machine Tool Builders' Association during the Past Year

The Need for Apprenticeship Training

"In 1907, the association adopted a machinist apprenticeship contract, and since that time has been providing engraved diplomas to be given to the apprentices on the successful completion of their terms. However, apprenticeship seems to have fallen into very much less favor than was current then. Some few of our members continue to call for the association diplomas, but the number now issued each year is almost negligible. It may be that we do not need apprentices under present-day conditions as we needed them in 1907, but we certainly do need to perpetuate the manual skill required in the production of machine tools. Whether this perpetuation is to be obtained by apprenticeship, or by some other method, is a problem of the industry today.

The Machine Tool Builders' Code of Ethics and its Value

"I rate the adoption of our code of ethics and the provision of a committee to enforce it as one of our outstanding achievements of the last few years. In all their relations with each other, men must necessarily be governed by codes of conduct, written or unwritten. These codes grow out of human experience that shows men what sort of conduct makes relationships the most happy and agreeable, as well as what sort of conduct makes their mutual relations unhappy and disagreeable. In the light of these experiences, men are respected by others according to the way they act.

"When we sit down at a table to eat with others, they expect us to have clean hands, and they expect our table manners to conform to commonly accepted standards of conduct. So in business, when we gathered around the business table, we recognized the desirability of having a little book of etiquette as a guide to what our industry considers to be good manners, at all times, and what it considers to be a safety code in times of business stress. The education of the members during the time that elapsed between the proposal and the final adoption of the code, has made the machine tool builders' life somewhat more agreeable than it was in the years 1921 and 1922. It has not been necessary, up to this time, for our committee on trade practices to function in any specific cases, and we hope that it will not be necessary at any time in the future. This does not mean that all the abuses aimed at have been eliminated, but they certainly have been checked, because no man who values the respect of his fellow men would care to be reprimanded, even privately, by this committee.

The Machine Tool Exposition in 1927

"Our latest activity, and it is one of outstanding importance, is to undertake the task of conducting the machine tool industry's own exposition. This marks the beginning of cooperation by American builders in constructive merchandising and in the reduction of competitive marketing waste. Such cooperation has long been made a success by the English and German machine tool industries, so that we are not starting anything new or untried.

"We know that the right kind of exposition has a proper place in the industry's marketing plans. But, heretofore, none of the expositions in which machine tools have been displayed has quite filled the specifications of what we need. Moreover, a multiplicity of expositions, none of which was quite of the right kind for us, simply meant much competitive waste of time and money. So there was every good, sound reason for our association to give the industry the kind of exposition it should have and could not get elsewhere. Our exposition has the enthusiastic, wholehearted support of the members, without whom no machine tool exposition can be a success. Therefore, it is our belief that the First National Machine Tool Builders' Exposition will have the most representative and the most complete display of machine tools that has ever been made.

The Place of Machine Tools in Industry

"I have no desire to place builders of machine tools on a pedestal of any sort. But I feel that, as co-workers in a basic industry, without which our modern civilization would not be possible, we should seriously consider the problem of placing the machine tool industry at least on the same level of respect that is held by those industries that could not exist without our tools.

"It seems to me that we are held below this proper level because salaries, wages, and profits in our industry are not on a par with those of other metal-working industries. It also seems to me that we shall not receive the respect our industry deserves, until we put these items upon a par with similar items in the industries of our own customers.

"This industry, on which all others depend for reduction in costs of production, should be able to enlist and retain in its ranks, the best of engineers, the best of salesmen, the best of executives, and the best of workmen. To do so, it must be able to pay all such men at least as much as other industries will pay them. But, since the days of the bicycle, we have seen production shops hire away our best workmen,

our foremen, and our executives, at wages or salaries that we could not afford to pay.

"Look about this industry today, and note how few of our successful concerns are over thirty-five years old and in the hands of a competent second generation of management. It is a serious and pressing problem to enlist, train, and keep the sort of personnel that the industry requires under present conditions. The bed rock foundation for the solution of that problem lies in providing adequate compensation for such a staff, compensation that is high enough to keep such men from leaving this industry and taking employment in the shops of the industry's own customers, at rates higher than we can afford to pay them.

The Machine Tool Builder's Part in Furthering Industrial Progress

"With the possible exception of automobile manufacturers, machine tool builders have devoted more time than any other group of machine manufacturers, to developing, designing, and building new and better machines. Our new machines perform intricate and accurate operations at an almost unbelievable rate. New methods have been devised by us all for saving time in the making of all kinds of machinery and metal goods. The pressure for still better methods is so strong that the new machine of yesterday becomes obsolete almost tomorrow, by reason of the initiative and activity of some wide-awake builder of machine tools. In contrast, there are other machine building lines that have developed almost no improvement in the last ten years or more. Yet these industries can and do secure a higher percentage of return than ours, in which so much brain work, labor, and capital are being expended.

"For many years the machine tool industry has been noted for relatively low compensation of its whole personnel, as well as for relatively low returns on its capital, and relatively high risk and business mortality. While this has always been extremely important to our industry, it has not been of much importance to the industry's customers. In days past, their own needs for simple, rough-and-ready machine tools of low productivity could be met, and were met, by the starting up of new machine tool shops faster than the old ones failed and passed out of the picture. But today, with mass production of all kinds increasing by leaps and bounds, the machine tool using industries have much greater need for a better organized, more vigorous, more substantial, and more progressive machine tool industry. Builders of other machines, who aim to go on building the same machine in quantities year after year, well know that you who devise new machines make it possible for them to cut their costs, and increase their profits. It should not be difficult to convince them that you deserve not only a respectable, but a generous return for your effort. You have the best kind of background for insisting on a proper return for the future benefit of your customers themselves.

Machine Tools Cannot be Built by Mass Production Methods

"Some machine tool builders have been led astray by the will-o'-the-wisp of mass production or manufacturing. Machine tools cannot, except in a few cases, be manufactured. They must be built to order, and the amount of special equipment involved in the average order is amazing to one not familiar with the practice of the industry. Overhead and development charges, per machine, are consequently high, and the reason for this must be made clear to the buyer if he does not realize its existence.

"The machine tool industry must fail to do its full share in advancing civilization if it does not secure prices that generously reward its work. It has failed to do this in the last five years, as shown by the heavy losses our industry has sustained through business failures in that time.

"Let us have proper cost systems, that will show, besides the current cash costs for labor and material, the necessary cost of idleness, the cost of plant replacement measured in our depreciated dollars, and the cost of development work. Let us pay adequate compensation for competent labor, management, and engineering. Let us make sales policies constantly conform to the principles of conduct so well outlined by this association.

Plea for a Broader Industrial Outlook

"But I urge, with all seriousness, that in doing so, you each give broad-visioned consideration to this industry and your own company as parts of the mechanical foundation of our modern civilization. I urge that you plan your individual management and selling policies not entirely with reference to your individual problems of today, but that you also look ahead some years and plan to keep your business alive that long. I also urge you to keep in mind the problems of the machine tool industry as a whole. I urge that you do everything possible to enable this industry to employ the best engineering talent, and the best workmen, and to compensate the owners of its capital adequately—otherwise all other industry must suffer.

"I would have every member of this association understand the necessity of a broad outlook on these subjects, and I would have all of you work to those ends. For with such vision and action, you will be better able to serve yourselves, to serve the machine tool industry, and to serve the industries that depend on us for the development and production of better and better 'Master Tools.'"

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FALL MEETING OF AMERICAN WELDING SOCIETY

An advance program for the fall meeting of the American Welding Society to be held in Buffalo, N. Y., November 16 to 19, has been published. At the meeting the following papers will be read: "Welding of Locomotive Parts," by M. Gjersten, master welder, Northern Pacific Co.; "Organization of Welding on the Railroad," by F. H. Williams, assistant test engineer, Canadian National Railways; "Comparative Tests on Arc and Riveted Structural Members," by A. M. Candy, general engineering department, Westinghouse Electric & Mfg. Co.; and "Tests on Welded Roof Truss," by H. H. Moss, Linde Air Products Co. In addition, there will be a symposium relating to welding science in the engineering curriculum of universities, at which a number of well-known educators will speak. Meetings will also be held by the welding wire specifications committee and by the American Bureau of Welding. A short technical session on welding in a gaseous atmosphere, including demonstrations, will be held Friday morning, November 19, the subject being dealt with by P. P. Alexander and R. A. Weinman of the General Electric Co.

In connection with the meeting one of the largest welding expositions ever held will show new developments in welding apparatus and supplies, as well as a large variety of welded products.

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NEW INDUSTRIES PROVIDE NEW OUTLETS FOR MACHINE SHOP EQUIPMENT

The rapid development of the mechanical refrigeration machine for household use is a good example of the creation of an entirely new industry, requiring the use of machine tools and equipment that must be supplied by other industries. These new developments keep the older industries constantly active. Their needs present ever new problems to the older fields that must supply the manufacturing equipment. From 1920 to 1925 the output of mechanical refrigerators for household use approximately doubled each year. In 1925 the output quadrupled, and present indications are that the increase in 1926 has been at an even greater rate. A $20,000,000 factory recently built by one of the larger companies in the field has a total capacity of more than 1000 refrigeration units daily. Another company is erecting a plant costing $5,000,000, having a factory floor space of 600,000 square feet. Plants like these present an entirely new market for the machine tool and kindred industries, and as we progress in mechanical inventions, the builders of equipment for making these new devices will have constantly new markets.

American Gear Manufacturers' Convention

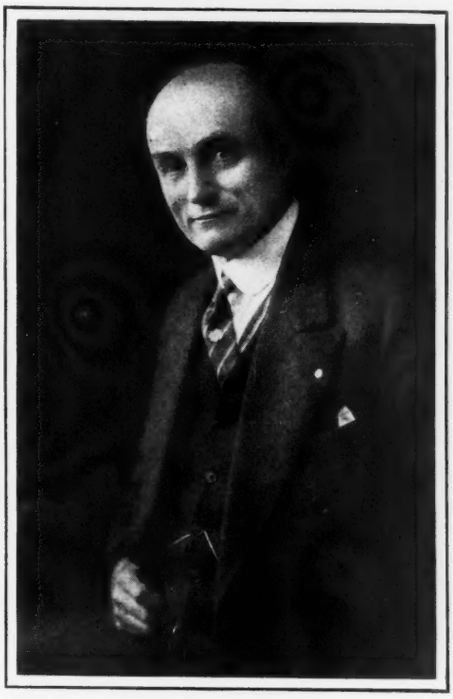
THE fall meeting of the American Gear Manufacturers' Association was held at Briarcliff, N. Y., October 14 to 16. As usual, the meeting was well attended by representatives of the member companies. The program included a number of addresses of great interest not only to gear manufacturers, but to the industrial field in general. The standardization activities of the association, for which it is especially noted, occupied the major part of the program, the same as at former meetings. Progress is constantly being made in gear standardization, in which work the association has taken a decided initiative. In many projects the association is cooperating as a sponsor body with the American Society of Mechanical Engineers under the recognized procedure of the American Engineering Standards Committee.

The President's Address

The president of the association, E. J. Frost, president of the Frost Gear & Forge Co., Jackson, Mich., in his opening address gave a comprehensive review of the activities of the association since its organization in March, 1917, by nine companies engaged in the gear manufacturing business. For the first six years Fred W. Sinram, now honorary president, served as president. Mr. Frost expressed appreciation of the valuable work done by Mr. Sinram during these early years, as well as of his continued efforts on behalf of the association.

In looking back over the record of the activities of the association, Mr. Frost stated that while the main accomplishment had been along the lines of technical standardization, a great deal had also been done to improve the commercial practices of the member companies. Standardized methods of finding costs have been studied, and while the dissimilarity of the work and equipment in the various shops complicates this problem, the work done has been of great value and has stimulated thought relative to proper methods of cost finding and cost keeping. Further work along this line is planned.

Concluding his address, Mr. Frost expressed the hope that the various standardization committees, both technical and commercial, would continue their work with energy and enthusiasm, so that at the next annual meeting, six months hence, another successful year of association work may be added to the record of past achievements.



E. J. Frost, President of the American Gear Manufacturers' Association

Secretary's Report and Papers Read Before the Meeting

The secretary of the association, T. W. Owen, in his report also made reference to the standardization work of the association, and called attention to the activities that will be engaged in during the next six months. He especially emphasized the fact that the spring meeting in 1927 will mark the tenth anniversary of the association, and this event could not be more fittingly celebrated than by having each standardization committee prepare for that meeting a complete final or progress report, so that the next annual meeting, marking ten years of successful existence of the association, might also be a definite mile-post in its main activity—that of standardization.

"Do We Know Our Business?" was the subject of an address prepared by W. H. Diefendorf of the Diefendorf Gear Corporation, Syracuse, N. Y. In this address, the author took as his keynote the statement "Valuable ideas do not pay unless put into practice." The object of the address was to stimulate interest in investigating the commercial questions entering into the gear business.

Another stimulating address was presented by C. E. Stuart, president of the Central Alloy Steel Corporation, Massillon, Ohio. He chose for his subject "America—the Keeper of the Keys." In this address, the leadership of America in the industrial, political, and social fields was emphasized. The reasons for this supremacy were pointed out, and suggestions made for its maintenance. In the course of his address, the speaker said: "We are rapidly learning that low costs through low wages is not the answer to increased prosperity, but low costs through production economies, improved methods, and waste elimination. * * * Standardization of production and mass production are playing a tremendous part in the greater opportunity of the individual worker."

The great value of trade association was also emphasized by the speaker. A few years ago, the joining of hands of competitors in the solution of problems common to all was considered to be more or less sentimental idealism. Today, the number of trade associations throughout the country may be counted by thousands, further linked up through great national organizations, such as the National Association of Manufacturers and the National Chamber of Commerce. The political stability and the social order of American institutions were pointed to as the underlying foundation upon which the nation's prosperity and well-being rest, and preservation of respect for the law was urged.

Conditions Covering the Use of Hypoid Gears

A paper on the use of hypoid gears was read by F. E. McMullen of the Gleason Works, Rochester, N. Y. In this paper, Mr. McMullen clearly indicated the field for this type of gears, covering the subject in a comparatively brief but comprehensive manner.

Hypoid gears are tapered gears having offset axes. They resemble spiral bevel gears in that each member has curved teeth, but the spiral angle of a hypoid gear is less than that of a spiral bevel gear. The hypoid pinion has a spiral angle equal to or greater than that of a spiral bevel pinion, and is considerably larger in diameter. These characteristics of offset axes, spiral angles, and pinion diameter account for the advantages of manufacture and operation of hypoid gears.

There is one major point that the hypoid development has permitted, and that is the ability to cut any type of tooth bearing that is desirable. For a long time, it has been known that gear teeth, when casehardened, become thicker and shorter. Small as this change is, it is sufficient to narrow the profile bearing contact appreciably. With "hypoids," it is practical to cut the tooth bearing slightly heavier at the

top and bottom than at the region of the pitch line and obtain an even weight of profile bearing after hardening. The lengthwise bearing can also be controlled and all bias bearing is eliminated. The same advantages of bearing control are obtainable in spiral bevel gears where the hypoid generator is used.

The principal advantages of hypoid gears are silent operation and strength. Spiral bevel gears have long met the demand for reasonably silent action. But when producing in quantities, where variations of material, machinery, heat-treatment, and grinding must be contended with, the hypoid gear can be made more easily than the spiral bevel gear. Nearly all rear axle gears are lapped to obtain an initial smoothness which would normally be obtained in 500 miles of car operation. This lapping operation can be performed more easily and more surely on hypoid gears as a consequence of the endwise motion of the tooth surfaces.

With spiral bevel gears, it is possible to spoil a pair by excessive lapping, which causes too great a confinement of the tooth action at the pitch line. With hypoid gears, the sliding motion is nearly uniform over the entire surface of the teeth, and the lapping operation smooths equally the entire bearing surface of the teeth.

Strength of Hypoid Gears

It is interesting to note that no one has yet succeeded in breaking any hypoid gears. Some of these gears have been subjected to unusual loads. The increased strength is due to the decreased spiral angle of the gear and the enlarged pinion. The reduction of spiral angle on the gear results in a decreased normal tooth load for a given transmitted load. The enlarged pinion diameter is of great importance, as it permits the use of larger pinion shanks than on spiral bevel gears intended for the same use. The added stiffness and decreased deflection of the pinion shaft has a decided effect. It prevents concentration of tooth load and permits the use of a longer tooth bearing.

Mounting Hypoid Gears

In general, the loads imposed by hypoid gears on the bearings are no greater than with spiral bevel gears of the same ring gear diameter. There is, however, a redistribution of the loads and direction of loading. Whenever a new mounting is being designed, either for spiral bevel gears or hypoid gears, careful consideration should be given to improving the gear mounting and reducing the deflection of the pinion. Experience has proved that the gear is not held rigidly enough, in many cases, to prevent springing away from the pinion. Attempts to overcome this weakness have been made, in some cases, by providing a thrust seat at the rim of the gear opposite the point of mesh. This scheme is faulty in that the amount of deflection allowed depends upon the judgment of the assembler. A webless type of gear with suitable ribbing on the differential case and sufficient spread of the differential bearings will provide a gear mounting that is stiff. The extra cost is little if any more than the conventional type.

The distance between bearings on the pinion shank where an overhung mounting is used is important. The amount of overhang of the pinion, that is, the distance from the center of load application on the teeth to the center line of the supporting bearing directly behind the teeth should not be greater than one-third the distance between the center of the bearings on the pinion shaft. Due to the pinion being above or below the center of the gear, the overhang of the hypoid pinion is greater than that of a spiral bevel pinion. Therefore, the spacing of supporting bearings that is correct for spiral bevel pinions will not be sufficient for a hypoid installation.

Hypoid gears are intended primarily for installations in the automotive field where large production will warrant the initial development work. This development cost at present is too great an item for economical manufacture in small quantities. Mr. McMullen's paper was illustrated by lantern slides showing many different applications of hypoid gears and conditions under which they are used.

Recent Developments in High-speed Chain Drives Standardization Reports

A paper of great interest entitled "Recent Developments in High-speed Chain Drives" was presented by George M. Bartlett of the Diamond Chain & Mfg. Co., Indianapolis, Ind. This paper contained a thorough analysis of the conditions surrounding the use of high-speed chain drives. An abstract of this paper will appear in December MACHINERY.

A large number of progress and final reports were presented by the numerous standardization committees. A report was also presented on the status of gear testing conducted at the Massachusetts Institute of Technology by Professor Earle Buckingham.

Among the reports approved was a recommended practice for transmission nomenclature, a recommended practice for automotive engine flywheel housings, a recommended practice for herringbone gears, a revision of recommended practice for holes, and a set of symbols for spur gear dimensions. These symbols will be published in a coming number of MACHINERY.

The spur gear committee presented a report in which it recommended certain standard formulas and practices for use in spur gear design. This report should be of value to anyone engaged in gear design, and will be published in a coming number of MACHINERY.

The membership committee reported the election of two new member companies, the Falk Corporation of Milwaukee, Wis., and the Skoda Works of Prague, Czecho-slovakia. The executive member of the latter firm will be the American representative of the Skoda Works, Joseph Kveton of Detroit, Mich.

The spring meeting of the association will be held at Jackson, Mich., but the date has not yet been decided upon.

* * *

CARTRIDGES THAT PREVENT CORROSION OF RIFLE BARRELS

A most interesting development in metallic ammunition has been announced by the Remington Arms Co., Inc., New York City. This consists of a formula for a priming mixture that eliminates rust, corrosion, and barrel pitting. Patents on this formula have been applied for. The Remington laboratories have been experimenting for several years with this new mixture, and in the course of this experimental work millions of 0.22 caliber cartridges have been fired. Rifle barrels through which thousands of these cartridges containing the new priming mixture, have been fired do not show the slightest signs of erosion, corrosion, rusting, or pitting. Similar barrels in which several thousands of cartridges were fired with ordinary ammunition were badly eroded, corroded, rusted, and pitted.

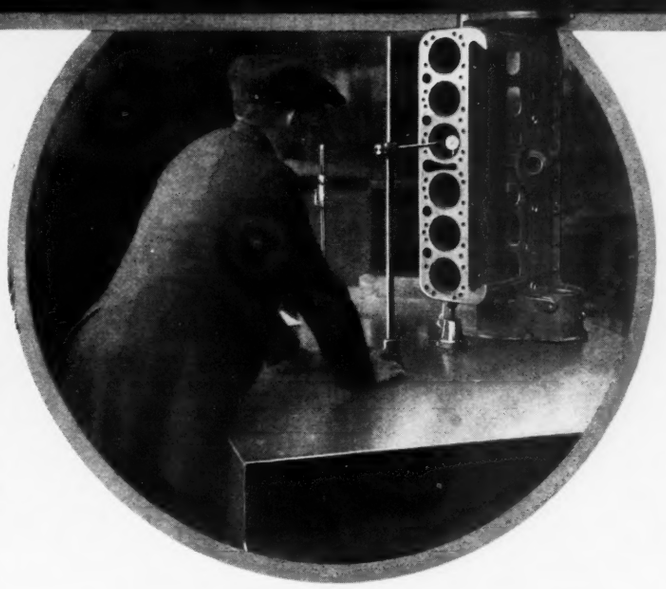
When cartridges with the new priming mixture are used exclusively, there is no need to use steel barrels of special non-corrosive steel. The exclusive use of cartridges containing the new priming mixture makes the inside of any rifle barrel rustless, stainless, and corrosion-proof; it is asserted by the Remington Arms Co. that when these cartridges are used exclusively, it is not even necessary to clean the inside of the rifle barrel. When a dry cloth is run through the barrel through which the new ammunition has been shot, to remove the powder residue, it comes out as clean as when inserted.

Old rifle barrels may be used with the new ammunition, provided they are thoroughly cleaned with boiling water, and if the new cartridges are used exclusively, the barrels will not rust or pit. If ordinary ammunition is used interchangeably with the new ammunition, difficulties from corrosion may be expected.

* * *

The Detroit Range, Boiler, and Steel Barrel Co., in a bulletin urging all users to apply the simplified practice recommendations of the Department of Commerce wherever possible, refers to Mr. Hoover as having "shown us the way to save millions of dollars in this one industry. The responsibility rests upon each individual to follow him as far as he can."

Inspection Devices in an Automobile Plant



Some of the More Unusual Gaging Equipment Used at the Plant of the Nash Motors Co. Kenosha, Wis. – First of Two Articles

By CHARLES O. HERB

MACHINING methods in automobile plants are controlled to a large extent by the machine tools used, and as a result, the operations in one plant are often duplicated in another. However, jigs, fixtures, and gaging equipment are almost invariably different, because it is generally necessary for designers to use original ideas to meet the needs of the individual plant. This and a succeeding article will describe in detail the construction of a number of inspection devices used in the Kenosha, Wis., plant of the Nash Motors Co. These devices are based on principles that could readily be applied in designing gaging equipment for many varieties of products.

When a regular vernier gear tooth caliper is used for checking the thickness of a bevel gear tooth on the pitch line in the plane of the pitch circle, the outside diameter of the gear must be accurate within close limits. This is necessary because the thickness of a bevel gear tooth varies from the outside toward the center of the gear, and unless the vernier caliper is applied in the plane of the pitch circle, it is difficult to know what the tooth thickness should be in the plane in which the caliper is applied.

Fig. 1 shows two sets of a gaging device designed for differential gears and pinions, which permits inspecting the thickness of a tooth on the pitch line at a definite distance from the center of the gear, and so it is not necessary to maintain the outside diameter within close limits. This device is also used for determining the radial accuracy of the teeth, and indicates whether or not the opposite teeth of gears having an equal number of teeth are in true alignment. When the thickness of a tooth is found to be incorrect by means of this device, an error may be indicated in either the pitch diameter or in the height from the bearing surface of the hub to the pitch line in the plane where the tooth thickness is being measured.

The gear or pinion to be inspected is slipped over stud *A*, with the ground hub of the gear located on a ground surface on stand *B* to which the stud is attached. Part *C* is then placed in position on the gear, as shown in the left-hand view, the hole in boss *D* closely fitting the stud, and the outside of this boss snugly fitting the hole in the gear. Slide *E*, to which are attached measuring feelers *F*, is next pushed down to bring the feelers into contact with a gear tooth. The distance between these feelers corresponds to the thickness of the gear tooth on the pitch line in the plane of the pitch circle, where this thickness is measured. If the tooth is of the proper thickness, slide *E* can be pushed down until a ledge on the slide comes in contact with the top of part *C*, but there should not be any backlash between feelers *F* and the tooth with which they come in contact. If the tooth is too thick to permit the slide to be pushed down until the ledge strikes part *C*, an idea of how great an error there is in the thickness may be obtained by slipping shims between the ledge and part *C*. When the tooth is less than the required thickness, the amount of error can be determined by applying an indicator against one side of part *C* and rocking this part while feelers *F* engage the tooth being inspected.

With the feelers of slide *E* held firmly against a tooth, the feelers of slide *G* should be pushed down on the tooth diametrically opposite, and if this can be done properly, the spacing of the pinion teeth is correct. Slides *E* and *G* are at unequal distances from the center of the gear which permits of checking the angle formed by the sides of any tooth. It will be apparent that this method also gives a check on the pitch diameter and on the height from the finished hub face to the plane of the pitch circle. This device is used principally in checking a new set-up of a gear-cutting machine.

Determining the Amount of Backlash in Bevel Gears

The amount of backlash in differential gears and pinions is determined by means of the gaging fixture illustrated in Fig. 3, which also enables checking the distance from the hub face of the pinion, or the back of the gear to the center of the mating part. In inspecting either a gear or a pinion, the mate is a master. It will be seen that the back of the gear rests on a vertically adjustable sleeve *A*, and that the hub of the pinion bears against a horizontally adjustable sleeve *B*. The face of the pinion hub is ground spherical to a radius equal to the distance between this surface and the center of the mating gear.

In setting up the fixture, sleeve *A* is adjusted to zero, part *C* is placed on this sleeve with the

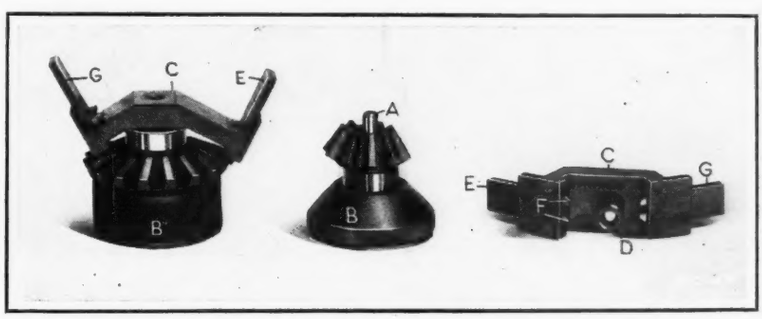


Fig. 1. Device used in checking the Tooth Thickness of Bevel Gears and the Radial Alignment of the Teeth

ground hub seating in the ground bore of the sleeve, after which sleeve *B* is adjusted to just come in contact with the large disk portion of part *C*. This disk portion is ground to a radius equal to the theoretical distance from the center of the gear to the spherical face of the pinion hub. For each graduation that either sleeve *A* or *B* is moved relative to an index line, the sleeve is adjusted 0.001 inch.

The gaging fixture is now set for receiving a pair of perfect gears, and so part *C* may be replaced with the gear to be tested, and a master pinion mounted on the forward ground end of handle *D* which extends through sleeve *B*. Sleeves *A* and *B* are adjusted to compensate for any error in the dimensions of the gear, and the amount of error is determined from the sleeve graduations. The gear teeth may now be tested for backlash by placing the contact point of the dial indicator against one of the gear teeth and then trying to revolve the gear while holding the master pinion stationary. From 0.004 to 0.008 inch of backlash is allowed. While the gear is in this fixture, the concentricity of the ground front hub can also be determined in the manner illustrated. In checking the backlash of a differential pinion, the process is, of course, the same as in the case of the gear, with the exception that a master gear is provided.

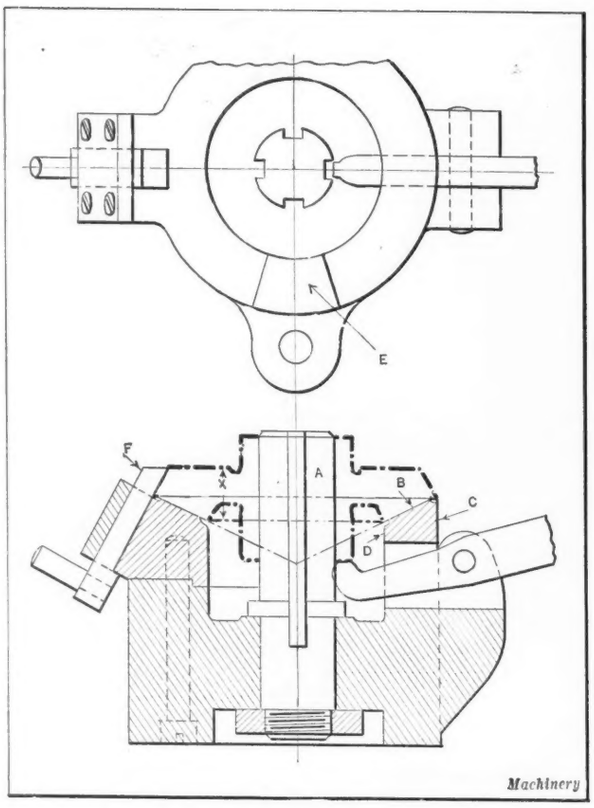


Fig. 2. Simple Gage employed in a Rough Inspection of Bevel Gear Blanks

A gage used for roughly inspecting the outside and inside diameters of the tooth face, and the back and face angles of differential gear blanks, is shown in Fig. 2. Dimension *X* is also checked. The blank to be gaged is simply mounted on a splined post *A*, and slid down until the gear face comes in contact with the hardened and ground surface *B* of the gage. The accuracy of the outside diameter of the blank is then inspected by observing the location of the outside corner relative to the corner formed by surfaces *B* and *C* of the gage. A slight recess ground in surface *B* near the outer end represents the limits specified for the outside diameter. The inside diameter of the gear face is checked by observing the relation of the inner end of the face to the corner formed by surfaces *B* and *D*, a recess also being ground at this end of surface *B* to represent the limits on this dimension. The relation between the work and the gage at this point may be readily observed because the gage-block is cut away at *E*, as shown in the plan view. The accuracy of the face angle can also be observed at this point by noticing the contact of the tooth face with surface *B*.

To determine the accuracy of the back angle, slide *F* is pushed along the corresponding surface of the gear, and the amount of space is observed between the slide and this gear surface. Dimension *X* is checked by observing the relation of the top of slide *F* with the back of the gear. Limit steps are ground on the slide for this surface. The checks on the two diameters are not of great importance, because the gear tooth thickness is tested later in the manner already outlined.

Inspecting the Pitch Diameter and Concentricity of Spur and Helical Gears

Fig. 4 illustrates an inspection fixture used for checking the pitch diameter and the uniformity and concentricity of the pitch circle of spur and helical gears. The gear *A* to be inspected is meshed with a master gear *B* for the inspection. Gear *A* is mounted on a slide *C* that is normally moved toward the right by a coil spring. Slide *C* is connected by levers to an indicator bar, which registers along the enlarged scale *D* with the result that the amount of movement of slide *C* can readily be determined by reference to the indicator and scale.

For inspecting, the slide on which the master gear *B* is mounted is placed in such a position that when gear *A* is meshed with the master, the indicator will register zero, provided the pitch diameter of gear *A* is correct. Hence, any error in the pitch diameter of gear *A* will be shown by a deviation of the indicator from the zero graduation, and if the pitch circle is not concentric or uniform, this fact will be shown by movements of the indicator as the gear and master are rotated together. A movement of 0.001 inch of the gear carriage moves the indicator a distance of 5/32 inch, and so small inaccuracies are readily noticeable. Master *B* is accurately placed in the proper longitudinal position along the base by revolving thumbwheel *E* and the head of micrometer *F*. The various arbors on the board behind this

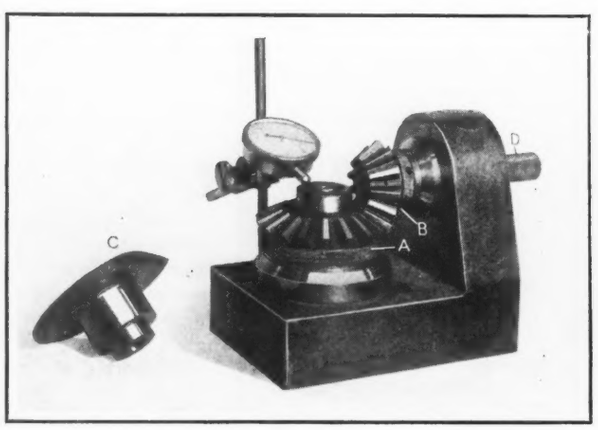


Fig. 3. Fixture used in testing Differential Gears and Pinions for Backlash

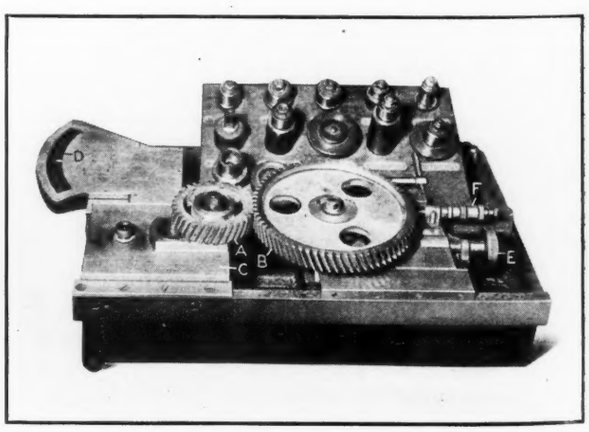


Fig. 4. Checking the Pitch Diameter and Pitch Circle Concentricity and Uniformity of Spur and Helical Gears

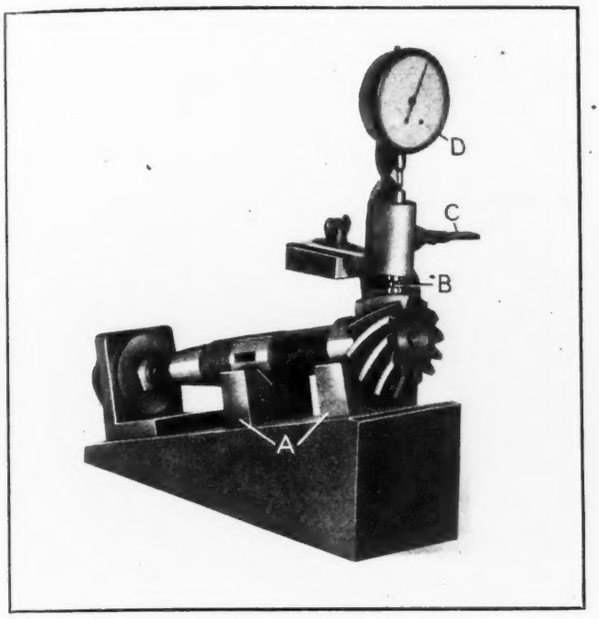


Fig. 5. Method of inspecting the Concentricity of the Pitch Circle of Spiral-bevel Pinion Teeth

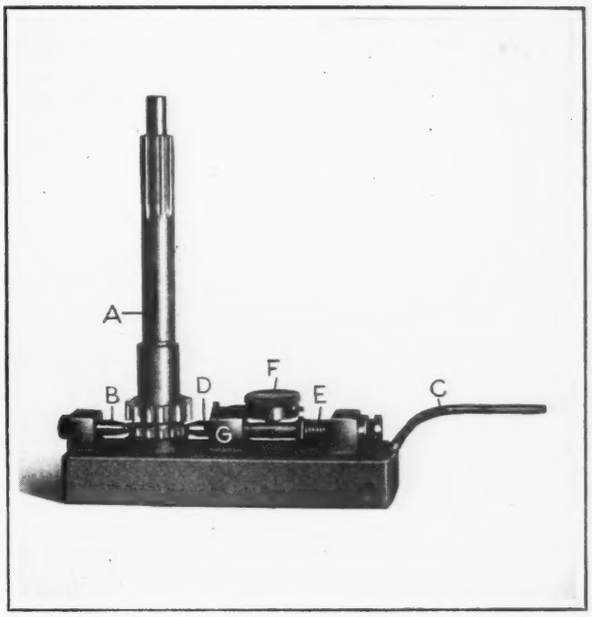


Fig. 6. Simple Fixture by Means of which the Clutch Teeth of the Clutch Shaft are inspected

fixture are of different diameters to suit a wide range of gears.

Checking Spiral-bevel Gears for Concentricity

In Fig. 5, there is shown a simple inspection device designed for checking the concentricity of the spiral-bevel teeth of the pinion mounted on the rear axle drive shaft. Two ground bearings on this shaft are supported by V-blocks *A*, which hold the shaft at an angle that is the complement of the face angle of the gear. The end of the shaft opposite that on which the pinion is mounted, is supported by a center which enters a center hole used in grinding the shaft bearings. This center support is not actually necessary, but gives a check on the grinding.

After the work has been placed in position, the ball end of part *B* is successively entered between all the teeth of the gear, the shaft being rotated to effect this and part *B* raised as required by means of handle *C*, and lowered through the action of a coil spring. The contact point of the dial indicator *D* bears against the upper end of part *B*, with the result that any deviation in the vertical position of part *B* as the ball end is placed between successive pinion teeth, will be shown by the indicator needle. The indicator mounting is held on a slide so that an inspection can be made at either end or in the middle of the teeth. It is not important that the ball end of part *B* register at any particular point along the face of a gear, as long as it registers at the same point on all the teeth. Similarly, the ball end need not be tangential with the pitch line of the gear teeth, although it is so designed.

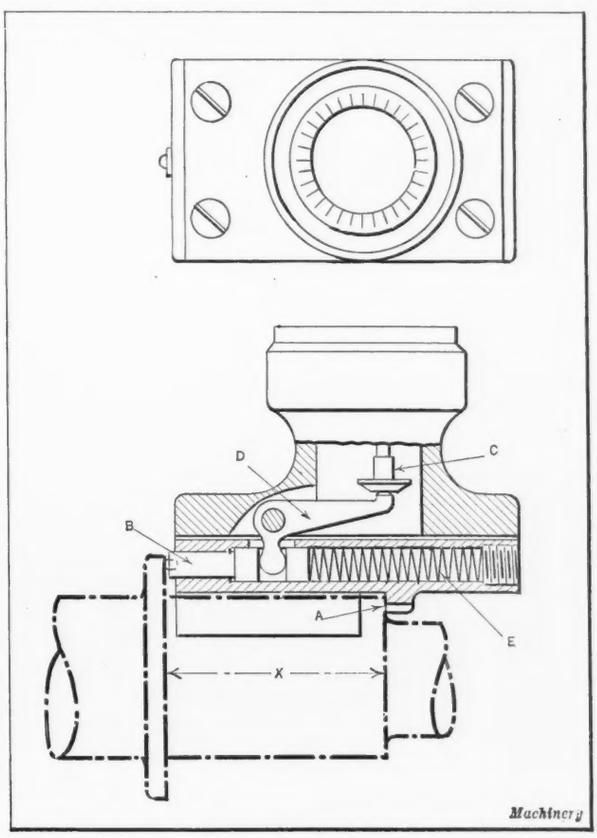


Fig. 7. Indicator Gage used in inspecting the Distance between Two Shoulders on a Shaft

The clutch teeth of the clutch shaft are inspected for pitch diameter by means of the device illustrated in Fig. 6. These teeth have generously rounded corners. The clutch shaft *A* is placed vertically on the base of the fixture, as illustrated, with the flanks of two clutch teeth in contact with a ball in the stationary holder *B*. Handle *C* must be depressed to pull plunger *D* back against the action of spring *E*, so as to permit the work to be placed between holder *B* and the plunger.

When the work has been positioned, handle *C* is released, so that spring *E* may push plunger *D* forward, a ball in the front end of the plunger coming into contact with two tooth flanks diametrically opposite those engaged by the ball in holder *B*. Mounted on the plunger is a dial indicator *F*, and the extent to which the ball in plunger *D* enters the clutch teeth governs the position of the indicator relative to the stationary block *G* against which the contact point of the indicator bears. When a master is placed between the two measuring balls, the indicator dial is set to zero, and then any deviation of the indicator needle during the inspection of work shows an error in the pitch diameter of the work.

Gaging the Width between Shoulders

Whenever possible, inspection devices equipped with dial indicators are so constructed that the pressure on the indicator is reduced rather than increased when the work is placed in the device. It is claimed that this construction increases the life of indicators of this type. The principle is well illustrated in Figs. 8 and 9, which show a gaging fixture used for checking the width between the shoulders of a universal joint yoke *A*. To permit placing the work in the

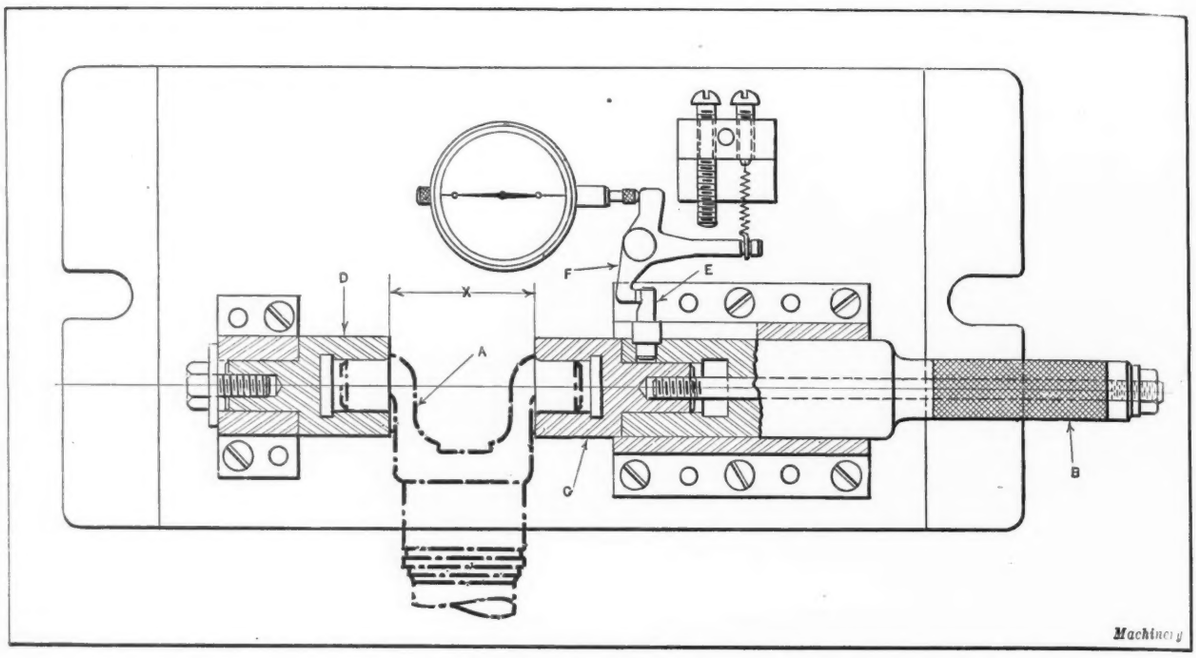


Fig. 8. Plan View of the Gaging Fixture illustrated in Fig. 9

fixture, handle *B* is pulled to the right, drawing collar *C* with it. The ground journal on one side of the yoke may then be inserted in the ground hole of collar *D*, after which handle *B* is gradually pushed toward the left to permit sliding collar *C* over the second journal of the yoke until the two shoulders of the yoke are firmly in contact with the faces of the two collars.

Pin *E* slides back and forth with collar *C*, and as the collar is pushed on the work this pin bears against one end of lever *F*. The opposite end of this lever is held against the contact point of the dial indicator, and thus causes the indicator needle to move according to the movement of pin *E*. In this manner, variations in the width between the shoulders of the yoke may be easily determined by reference to the dial. It will be observed that the pressure on the indicator is reduced as pin *E* is pushed to the left. A small spring holds lever *F* in contact with pin *E* when the latter is near the extreme left-hand position, but as the pin is pulled toward the right, a stop-screw prevents the lever from following the pin, and thus guards against excess pressure on the spindle of the indicator.

Master *G*, Fig. 9, is employed to set the device for checking work. With the master held between the two collars in place of the work, the dial of the indicator is turned to zero. The limits on the dimension checked are plus 0.001 and minus 0.002 inch. The graduations on the dial that represent these limits are blacked solid to facilitate the inspection; thus it is merely necessary for the inspector to observe when the needle moves beyond the black area, and this results in far less eye fatigue than when the inspector must observe certain fine graduation lines. From Fig. 8 it will be apparent that collars *C* and *D* can be easily replaced.

A dial indicator gage used for inspecting the distance between two shoulders on a shaft is illustrated in Fig. 7. Dimension *X* is checked, and must be true within plus or minus 0.001 inch. The bottom of the gage is ground to a vee so that it will conveniently rest on the shaft. The inspection is accomplished by simply sliding the gage along the shaft until ledge *A* comes in contact with one shoulder, as shown. The diamond point of plunger *B* will then come in contact with the second shoulder, and as the movement of plunger *B* is conveyed to the contact point *C* of the dial indicator through lever *D*, any variation in dimension *X* from the theoretical size can be read from the indicator. Coil spring *E* normally keeps plunger *B* extended a longitudinal distance from ledge *A* that is a certain amount greater than dimension *X*. A master is also used for setting the indicator of this gage to read zero when dimension *X* is true. Diamonds are provided wherever possible for the contact points of dial indicators used in this shop.

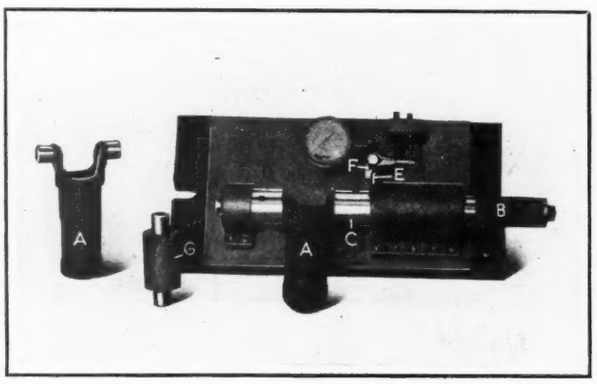


Fig. 9. Inspection Device arranged for checking the Distance between Two Shoulders of a Universal Joint Yoke

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INDUSTRIAL MACHINERY IN INDIA

Imports of industrial machinery into India during the last fiscal year for which complete returns are available, amounted to slightly over $39,000,000, a decline of $11,000,000, or approximately 22 per cent, from the imports during the preceding year. Of the imports, 84 per cent came from the United Kingdom, as compared with 87 per cent during the preceding year. Nine per cent came from the United States, representing a value of $3,600,000, an increase from 8 per cent during the previous year.

Since 1921, there has been a severe decline in the imports of industrial machinery into India. In 1919 and 1920, there was an industrial boom, and India passed through a period of intense industrial promotion, largely under British influence, but using native capital. This development, often without sufficiently experienced management and with undeveloped channels of distribution, resulted in many disappointments, and hence, was followed by a decline in the importation of industrial machinery. The textile machinery imports suffered the most severe decline of all the various classes of machinery imported into India. Of the total metal-working machinery imports, the United Kingdom supplied about 75 per cent, while the United States supplied about 13 per cent. Germany came third, with approximately 6 per cent.

Preventing Waste in the Shop

By J. SETON GRAY, Industrial Engineer, Milwaukee, Wis.

IT is not so well understood by the men in the factory as it ought to be that the less waste there is in industry, the more money will there be to distribute in wages, as well as in dividends. Employes cannot expect increases in wages so long as there is a continuance of waste that eats up the difference between the company's income and expenses. As the man in the shop becomes more familiar with management problems, he will insist on waste elimination, so that he may share in the increased prosperity that is bound to result. These increased earnings, due to waste elimination, are, as a general rule, ultimately shared by the customers, the stockholders, and the employes. A factory or a business enterprise will exist only as long as there is a profit earned. If waste occurs that makes it impossible to show a profit over the manufacturing cost of the product, it is only a matter of time before the doors will be closed.

Scrapped Parts are a Common Cause of Heavy Losses

In many factories, very little attention is paid to the amount of material scrapped. It is looked on as a necessary evil, and foremen expect that there will be a certain amount of scrap every day. No effort is made to check up on the number and value of pieces scrapped in each department. This waste in one factory ran up to $10,000 a month before an effort was made to interest the foremen in reducing the scrap. A continuous check was then made on the scrap for over a year. This resulted in a steady improvement month by month; and finally a low level of $1400, with practically the same amount of production, was reached. If the management does not display any interest in the amount of material scrapped, how can there be any interest on the part of the foremen or the shop men? This is also true of material that is rejected and must be remachined.

Frequently neither the foreman nor the men in a department fully appreciate the waste due to material being scrapped as a result of errors in machining. This difficulty is looked upon as a necessary evil, and in many shops no effective means are provided for checking up the amount of material scrapped in each department and its value. In one plant, this waste ran up to $10,000 a month before steps were taken to point out to the foremen that the scrap could be reduced. Then a system of reports was instituted that showed the amount of scrap produced daily and who was responsible for it. This led to a steady improvement, month by month, until after a year, with the same production, the value of the scrap amounted to only $1400 a month.

Shop Supplies are Often Carelessly Wasted

Shop supplies should be handled in such a way that an accurate check can be made of them. No material should be issued from the store-room without a requisition, and every foreman should have a statement submitted to him at the end of the month, listing his supplies and their value. The fuel oil used in the annealing furnaces in one plant was cut in half as soon as the foreman of this department knew that the consumption was being checked up. The number of rivets used in a certain factory was out of all proportion to the rivets in the finished product. When the foreman learned that his requisitions for rivets were being checked up against his production, very few rivets were left lying around the floor. This was also found to be the case when the consumption of waste, rags, and oil was checked up.

One must be very careful in talking about savings in oil consumption, as a few less drops of oil may mean a hot bearing, the replacing of which will cost a great deal more than the amount of money represented by the saving of oil over a period of many months. At the same time, oil should be used and not wasted. If no check is made on an oiler, he will err on the safe side and use twice or three times the amount of oil that is really necessary. When a man can get all the waste and rags that he thinks he needs, he will wipe his hands with a new ball of waste and throw it away. If, however, he knows that a check is being made on the consumption of waste, he will be a little more careful and actually use waste, not waste it.

In factories where there are a great many machining operations, the cost of small drills, reamers, and other perishable tools is likely to run quite high, unless watched carefully. One manager was very much surprised to learn that these tools cost nearly $3000 per month, or about 37 cents per unit of production. After a systematic check had been inaugurated and the foremen knew efforts were being made to check up on these broken tools, the cost was gradually brought down to less than 10 cents per unit of production.

In a factory assembling automobiles, the management was surprised to learn, at the end of the year, that it paid $50,000 more for spark plugs than the production really warranted. It was too easy to get this material, and when the proper amount of material was issued for each car built, and no more, this waste was stopped.

Savings Due to Elimination of Unnecessary Transportation of Materials

A poor factory lay-out, which calls for long hauls of material from one department to another, is responsible for a great deal of the cost of production in many factories. Wherever possible, material should flow through the factory in a straight line, and not double back on itself. When the factory is on several floors, the raw material should be taken to the top floor first, and gradually work down until it reaches the lower floor and the shipping platform. Wherever there is a lot of handling to be done, you will find there is a lot of waste.

In many factories, the various departments have an arbitrary number of men, set by the general superintendent, regardless of the amount of work being performed. This is particularly true of repair gangs, where the same number of men are kept on the payroll at all times. In one establishment, where a great deal of piping was used in process work, the pipe fitting gang was placed at fifteen men. Due to a business depression, when men left, they were not replaced until the gang shrank to eleven men. Then the foreman, noticing the condition, immediately hired four new men for his department, feeling that if he demonstrated his ability to get along with a smaller gang, in time his allowance would be cut.

This condition is present in many factories, especially where the foremen do not understand the first principles of a foreman's job. The general superintendent as well as the foremen should be interested in holding down their labor charges to a minimum, and not be tied to a set number of men, unless the work performed is of such a nature that it can be absolutely gaged. The man power in every department, especially the departments that are generally classed as non-productive, must bear some relation to the actual factory production if labor costs are to be controlled within reasonable limits.

Over-equipment is one of the great causes for waste, because, as one factory manager put it: "Old man Interest is at work, whether machinery or equipment is producing or not."

The carrying of a large stock of material creates waste, as it ties up capital that could be used for other purposes. On the other hand, too little stock may slow up the total production, so that men and machines will be idle. A well balanced stock means just enough to allow the factory to be operated at the best rate of speed, all machines being run to capacity. This should be accomplished with as small an inventory as possible and a minimum of stock in process.

Over-time Work is Often a Costly Luxury due to Lack of Proper Planning

Over-time is more costly than straight time, and the effort obtained from the men is not nearly so great. If a man is compelled to work longer than the customary working day for any length of time, he loses interest in his job. In these days of intensified production, a certain length of time must be provided for rest and relaxation, and if part of this time is taken up with extra work, a man cannot remain an efficient producer, as his health is gradually impaired. Over-time should be used as a last resort, and then only for a limited period of time. There are occasions where over-time is imperative; but in most cases, arrangements can be made to operate a night crew and relieve the day men, when their full day's work has been completed.

Of course, breakdowns may occur in different parts of the factory which will hold up deliveries to other departments, and over-time may be essential to bring the schedule back in line again. However, over-time easily becomes a habit. It generally begins with one or two days preceding some important delivery date, and gradually builds up, so that if it is not watched closely, there will be a certain amount of over-time going on in the factory all the time.

The average workman does not care to work over-time. He realizes the waste, and feels that if he cannot earn enough money in a regular day to care for his family, there is something wrong with him personally or with his job. There are exceptions, of course, but that is the feeling of practically all men regarding over-time.

It should be made so hard to obtain permission to work over-time that a foreman will only seek such permission when a real emergency calls for it. Every case should be taken up personally with the superintendent, and a written statement submitted why over-time is necessary. When a man is compelled to write down his reasons for certain actions, he is very careful to see that these reasons are above criticism.

Machinery and equipment cannot be closed down during the day without causing a loss of production. Whenever possible, repairs to equipment should be done at night. Everything should be in readiness, so that when the shut-down is made, the equipment will be out of service for the shortest possible time.

Quite often it is understood when a contract is accepted to perform certain work, that it must meet the delivery date, and frequently this work is taken on a "bonus-and-penalty" basis. Over-time must be resorted to in a case of this kind, and it is always policy to place the cards on the table, and let the men know just what must be done. If under such conditions the bonus is earned, the men should participate in it; and if they are told that they will, then look for real results with a minimum of over-time.

One of the most fertile fields for waste is when delivery dates are not met. This may be accounted for in a number of ways, but invariably the factory organization tries to meet these dates, which means the further upsetting of factory schedules and over-time.

How the Foreman Can Prevent Waste

If a foreman is so overloaded with detail work that he does not have time to sit down and do some constructive thinking, then you can be sure there is waste in his department. This waste may take many forms, but all tend to reduce profits. Men who are responsible for the work of other men must have time to do their planning and thinking; otherwise the best results cannot be expected.

Lack of accurate knowledge on the part of the foreman of what is going on in his department, generally means that there will be considerable waste. In one factory it was decided that all information covering time distribution in the various departments would be furnished to the foremen just as soon as it had been compiled by the works accountant. Below is given a comparison for one particular department, showing how certain waste of time was eliminated or reduced, as soon as this information was given to the men in charge. The figures in the first column represent the average daily time before information relating to the charges was given to the foreman, and the figures in the second column show how the time was reduced after the foreman was apprised of the conditions.

	Hours	Hours
Hours productive work on piece-work	678.0	578.0
Hours productive work on day work	39.0	19.0
Set-ups on day work	3.01	1.06
General repairs	19.0	8.1
Experimental work	8.5	6.5
Repairs to permanent tools	18.0	6.1
Attending hospital	1.9	0.76
Trucking	29.0	19.5
Handling	16.0	.....
Repairs to dies, jigs and fixtures	9.35	3.45
Cleaning up	19.4	10.7
Machine tool and power trouble	18.0	2.15
Waiting for crane and trucks	6.0	.....
Waiting for stock or assignment	5.0	.....
Supervision	69.0	68.0
Repairs to machinery and equipment	4.5	0.71

The production in this particular department is proportional to the number of hours worked on piece-work. When the foreman understood that the time distribution was being checked up, he was careful to see that all charges were warranted. For example, the time allowed for cleaning up was cut in half when the foreman understood that if he did not allow the department to get dirty, it would not be necessary to clean it up. All waste in any department or any factory can be controlled, if accurate information is placed in the hands of the men responsible.

The waste in any department can be reduced if accurate information is placed in the hands of the men responsible. The more the foremen in a shop know about the value of the supplies that are wasted, the more interest they will take in preventing the waste; but you cannot expect the foremen or the shop employes to take any more interest in the prevention of waste than the employer does himself. He must not countenance any waste where he is directly responsible, and he must furnish the foreman with the necessary facts and figures to know what they are doing. There is hardly a plant that is so well managed that there is not some waste going on in some of its departments. Accurate knowledge of costs will help to eliminate a great deal of this waste.

The more foremen know about waste, the better they will be able to prevent it, but you cannot expect the men or the foremen to take any more interest in the elimination of waste than the employer does himself. Let the employer furnish the foremen with the necessary facts and figures; these are the tools that a foreman needs in operating his department. In all factories today, costs can be reduced by the elimination of waste.

Waste of Power is an Important Loss in Many Plants

You will always find the boiler room a place where a lot of money goes up the chimney if not watched properly. It makes no difference whether hand-fired boilers are used or automatic stokers—if not given the proper care, there will be considerable waste. In the factory the waste multiplies,

especially if steam is used in the manufacturing process. The average operating foreman is not interested in the amount of steam he uses, but in the amount of production he gets out of his department. If he uses twice the amount of steam for 25 per cent more production, he brags about his production.

In one factory, where no check-up had ever been made, it was discovered that certain departments used the same amount of steam twenty-four hours a day, although they were only working nine hours a day. Investigation showed there was not even a valve in the line feeding the department, to shut off the steam when it was not operating. It is a good plan to measure the amount of steam used in the manufacturing process. The installation of steam-flow meters may be costly, but they will pay for themselves in a very short time.

The same may be said about electrical power. In many factories there is actually more power consumed in driving the friction load than is actually used in performing useful work. If a foreman understood that the amount of power used in running his department was one of the means of measuring his efficiency, he would look at power consumption in an entirely different light.

Waste from Too Low Steam and Air Pressure

Failure to maintain the required steam or air pressure in a plant often causes serious loss in production. This is especially true in a shop where a large number of pneumatic tools are in operation. In air, water, and steam lines there are also losses due to leakage or radiation if these lines are not properly maintained. Losses due to improper electrical installations are frequently found, but this is a subject on which the electrical engineer must be consulted. Voltage drops, for example, caused by too small feeders may become very serious. In one large plant where many motor-driven power presses obtained current from the same line, the voltage sometimes dropped to such an extent that the speed of the presses was decreased appreciably, affecting the piecerate earnings of the men. Losses due to belt slippage and lineshaft friction must also be considered, but these are engineering problems rather than simple management problems.

Starting and Stopping Work on Time Eliminates Waste

In a factory where there were a great many machine operations, it was decided to install recording meters so that the amount of power supplied to the different departments could be measured. After these meters had been installed, it was discovered that it was much more important to watch the starting and stopping records in these departments and leave the consumption of power to a later date. In one department in this factory, it actually took the operators ninety minutes in the morning before full load was recorded. The management allowed the operators a six-minute lunch period, but the recording meters showed the men were actually taking fifteen minutes for lunch.

At ten minutes before noon, the operators all over the factory started to quit so that they would be in the cafeteria before the other fellows and get quick service. Full load was not recorded after lunch until ten minutes after the starting whistle had blown. Twenty minutes before quitting time, the gang started to let up.

Taking all these elements into consideration, it was estimated that the average man in this factory was losing about eighty minutes a day, and as there were about two thousand men earning about sixty cents per hour, this waste assumed tremendous proportions. Just as soon as the foremen were shown the charts recording this condition, and understood that they were responsible for the conditions recorded, there was a marked improvement in the factory; and when last checked up, the starting and stopping record averaged a loss of only ten minutes per man-day.

Waste is Due to Many Causes—Some at First Sight Trivial

The telephone is a wonderful instrument, provided it is used properly. All factories should be equipped with telephones, so that a foreman can get in touch with anyone without leaving his own department. When, however, the telephone service is abused, it is likely to prove quite costly. A foreman in charge of a trucking department found that 40 per cent of his time was spent in answering calls. How could he efficiently handle his work when all calls were for emergency purposes, and how could the various foremen requesting such service be able to handle their work efficiently, when they did not see any further ahead than the present moment?

In many factories, it is the practice to have all windows painted so that nobody can see through them. How restful it is to be able to look outside, and see that the sky is blue, or notice that rain is falling. The mere glancing up creates a diversion, and a man will go on with his work with renewed energy after this slight diversion. This is especially true in an office building, where it is impossible for anyone to completely concentrate on his work for eight or nine hours at a stretch. In summer buildings should be properly aired, and in winter, they should be properly heated. How can a man be expected to produce if he is constantly thinking about how cold his feet are?

Absentees must be controlled if a factory intends to operate efficiently. No matter how good a man may be, if he cannot be depended on, and has the habit of laying off, the foreman will be further ahead if he lays him off permanently. This is especially true if the habitual absentees are operating expensive machines or equipment. The same can be said about men who make a practice of coming late to work. It sets a bad example to all the other men, and if a factory is to operate efficiently, discipline must be maintained.

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TOOLS FOR FACING STEAM-PIPE JOINTS

By J. R. PHELPS
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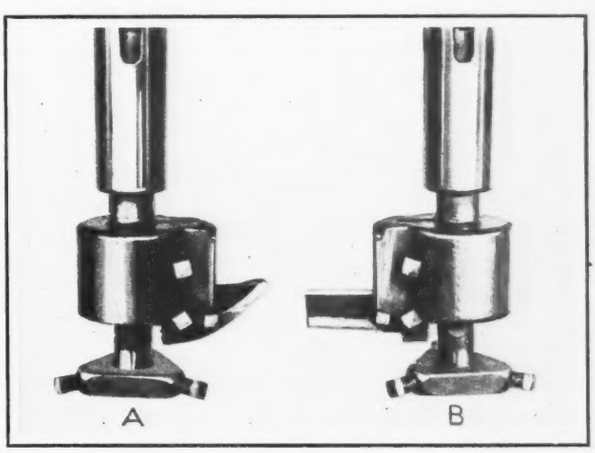
The machining of steam-pipe joints from rough castings was done formerly in the San Bernardino shops on a horizontal boring machine. After this operation, a radial drilling machine was used for drilling holes in the flanges. In order to avoid the use of two machines and perform both operations at one setting, special facing tools were constructed so that the drilling machine can now be used for both facing and drilling. The tool *A* in the illustration is for ball joints, and tool *B* for flat faces or joints. These tools have wide cutters, so that they machine the entire joint surface as the spindle is fed downward. Owing to the width of the cut, it is necessary to provide a rigid support for these tools, thus preventing any lateral deflection and chattering. This support is obtained by means of a triangular-shaped spider or pilot block. The pilot on the tool fits into a hole in the center of this block (see illustration), and the block itself is held rigidly within the steam pipe by means of three set-screws which provide means of clamping and adjusting.



Tools for facing Ball and Flat Steam-pipe Joints in Drilling Machine

Pinions Cut from Enlarged Blanks

Increased Strength of Enlarged Pinions and Data for Establishing Blank Sizes

By R. S. CONDON, Development Engineer, Kearney & Trecker Corporation, Milwaukee, Wis.

A SMALL spur pinion can be strengthened and interference can be avoided where it would otherwise occur by cutting the pinion from an over-size blank. Such a pinion will mesh properly with a standard gear at an increased center distance and at an increased pressure angle. The strength of a pinion of given pitch greatly decreases as its number of teeth is reduced, due to under-cutting of the teeth. Under-cutting can be reduced by cutting the pinion from an over-size blank, because the increase in blank diameter provides for lengthening the involute profile of its teeth and thus eliminates a portion of the under-cut tooth flank.

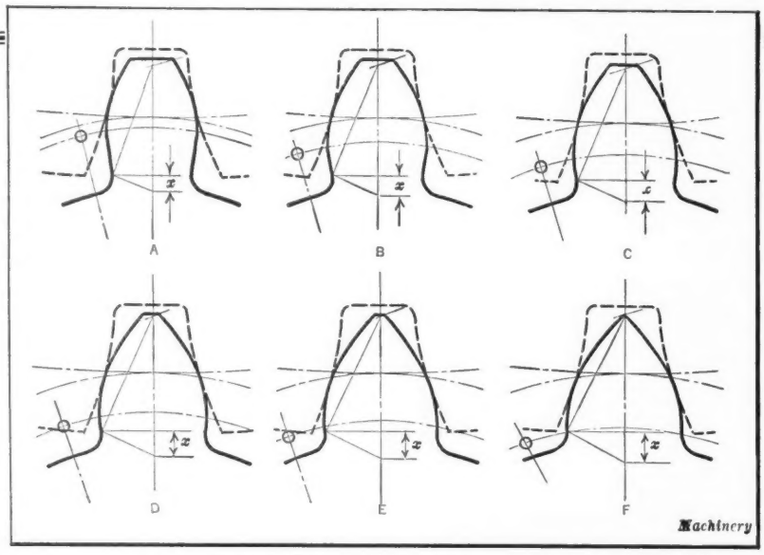


Fig. 1. (A) 10-tooth Standard; (B) 10-tooth, 10½-tooth-size; (C) 10-tooth, 10¾-tooth-size; (D) 10-tooth, 11-tooth-size; (E) 10-tooth, 11¼-tooth-size; (F) 10-tooth, 11½-tooth-size

Interference of 14 1/2-degree pressure angle standard gears, which occurs with pinions of from 22 to 31 teeth (depending upon the gear ratio) can be avoided with small pinions, of 7 to 11 teeth, which mesh with standard gears, by cutting the pinions from blanks that have been made sufficiently over-size. The scope of this article has been limited to a discussion of the improvement of spur pinions that mesh with standard gears.

The increase in strength of a small spur gear or pinion due to an increase in blank diameter is indicated in Fig. 1. Tooth *A* of a standard 10-tooth pinion, having a 14 1/2-degree presure angle, is modified as shown at *B*, *C*, *D*, *E*, and *F* by increasing the blank diameter by an amount that would make the respective blanks correct for a 10 1/2-tooth, 10 3/4-tooth, 11-tooth, 11 1/4-tooth, and 11 1/2-tooth standard pinion. The strength of each pinion tooth shown is proportional to the dimension x given at the base of each tooth. Two-thirds of dimension x divided by the circular pitch is the Lewis factor* and is a correct measure of the relative strength of each pinion tooth; hence, this factor may be used to compare the strength of each pinion tooth shown with the strength of any standard gear tooth. The curves in Fig. 2 show some interesting comparisons.

The lower curve in Fig. 2 shows the strength as indicated by the Lewis factor for 14 1/2-degree pressure angle standard gears, and the succeeding curves show the strength of gears whose outside diameters have been made over-size by an amount that would make their respective blanks correct for 1/2, 3/4, 1, 1 1/4, and 1 1/2 teeth more than are to be cut in them. It can be seen from Fig. 2 that a 10-tooth pinion cut from a gear blank that would otherwise be correct for an 11 1/4-tooth standard pinion has 175 per cent of the strength of a standard 10-tooth, 14 1/2-degree pressure angle pinion, and the over-size pinion is as strong as a standard 35-tooth gear. This over-size pinion is shown in Fig. 3 superimposed on a standard 10-tooth pinion.

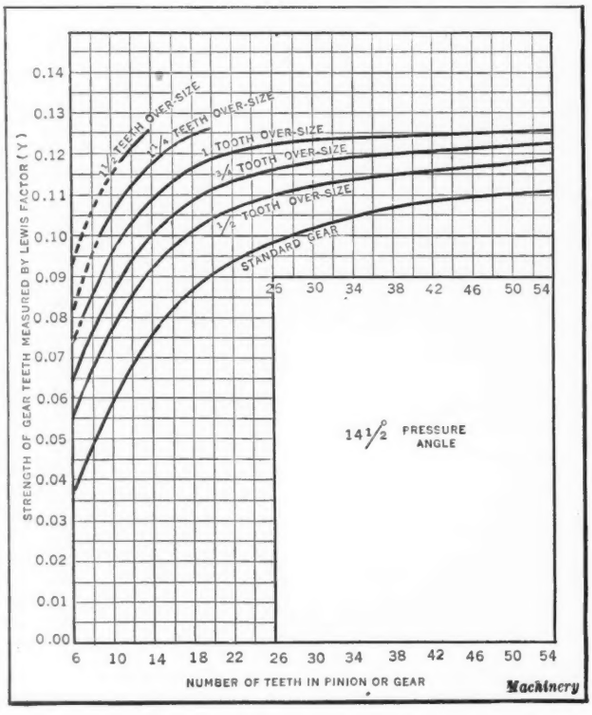


Fig. 2. Curves indicating Relative Strength of Gear Teeth for Standard Gear and for Gears cut from Over-size Blanks

The Question of Tooth Interference

Interference of the teeth of standard gears with the teeth of standard pinions occurs with pinions as small as or smaller than 22 teeth for 14 1/2-degree pressure angle gears and 12 teeth for 20-degree pressure angle gears. In Table 1 the largest number of teeth for standard gears is listed opposite the number of teeth in the smallest standard pinion that may be used without interference. The extent of modification of the pinion to avoid interference will be considered later.

The "interference points" may be found (see Fig. 4) by drawing lines through the center of each gear, making angles with the common center line of the gears equal to the effective pressure angle (the angle made between the common tangent to the base circles and a perpendicular

*For a complete explanation, see "Spur and Bevel Gearing," page 57, paragraph entitled "Derivation of the Lewis Formula" (published by MACHINERY).

TABLE 1. MINIMUM NUMBER OF TEETH IN STANDARD PINIONS THAT WILL MESH WITHOUT INTERFERENCE WITH STANDARD GEARS LISTED

14½-degree Pressure Angle		20-degree Pressure Angle	
No. of Teeth in Pinion	Maximum No. of Teeth in Gear	No. of Teeth in Pinion	Maximum No. of Teeth in Gear
22	22*	12	12*
23	23	13	15
24	27	14	26
26	39	15	47
28	68	16	100
30	127	17	820
32	Rack	18	Rack

Machinery

*Slight interference

to the common center line at the pitch point); the intersection of each of these lines with the base circle of each particular gear is the interference point. Points *B*, *B'*, *C*, and *C'* are interference points in Fig. 4. In Figs. 1 and 3 the interference points are circumscribed with minute circles. In order to avoid tooth interference, the interference points of one gear must lie outside the addendum circles of its mating gear, because involute action between two gear teeth cannot occur beyond their involute contours, and the involute contour of the teeth of any gear starts at its base circle. It will be noticed that avoiding interference between the teeth of a standard gear and the teeth of its mating enlarged pinion fixes the minimum amount that the pinion blank must be made over-size. The recommended sizes of pinion blanks and mating gears are given in Tables 3 and 4.

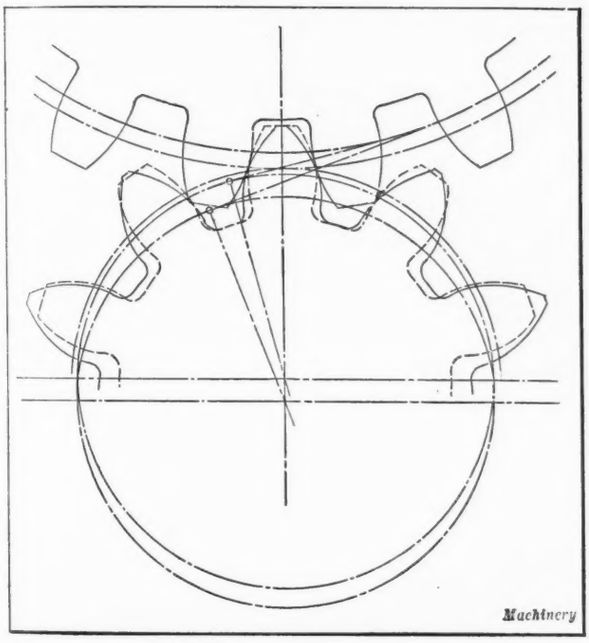


Fig. 3. Dotted Lines show 10-tooth Standard Pinion, and Full Lines 10-tooth Pinion of 11¼ Tooth Size

Increase in Center Distance and Pressure Angle

A gear that is cut from an over-size blank will operate at an increased center distance with its mating standard gear. The amount of increase in center distance will be equal to one-half the increase in blank diameter, or the increase in blank radius of the enlarged gear. It is convenient to specify the blank size of an enlarged gear as a "tooth size," that is, the number of teeth for which the blank would be correct if the gear were to be standard, so that in solving for the new center distance between a standard gear and its mating over-size pinion, the "tooth size" of the pinion is used in the calculation instead of the number of teeth actually cut in the pinion.

A pinion that is cut from an over-size blank will operate at an increased pressure angle with its mating standard gear due to the increase in center distance between the gears (see Fig. 4). The new "effective" pressure angle may be determined as follows:

$$\text{Cosine of new pressure angle} = \frac{\text{Standard center distance}}{\text{New center distance}} \times \text{Cosine of pressure angle of mating standard gear}$$

An examination into the load on the gear teeth and bearing loads developed in a gear train necessitates a clear understanding of the location and direction of the driving force. When one gear drives another, all points of contact between the two gears occur along the common tangent to their base circles; this common tangent is called the "line of action." The pressure angle of standard gears gives the direction of the line of action (see Fig. 4). It is probably within the limits of practical accuracy to assume, in this discussion, that the driving force between two gears is normal to their teeth at all points of contact—as the direction of the frictional resistance reverses on each side of the pitch point—and therefore it can be considered that the driving force lies along and in the direction of the line of action.

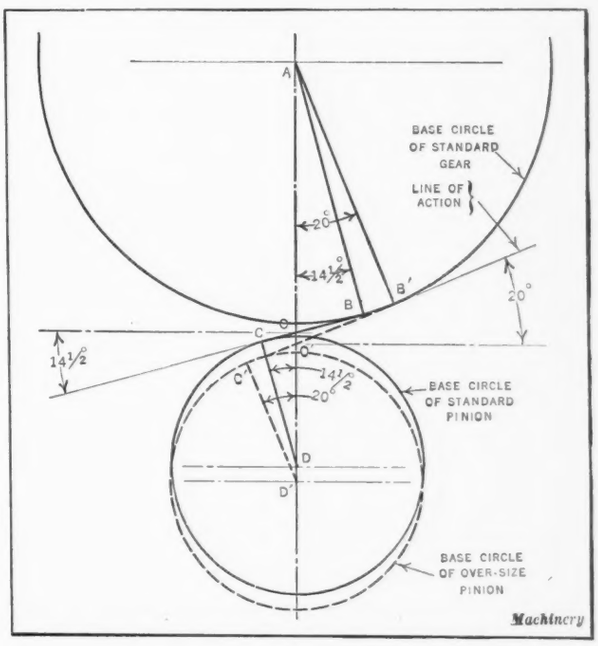


Fig. 4. Relative Positions of Base Circles of a Standard Pinion and an Over-size Pinion

In investigating the tooth loads and bearing loads, it is convenient to consider the force of compression between the gear teeth of each pair of mating gears replaced by a force of tension in a rope of an analogous mechanism in which the rope winds up on the driving drum and unwinds from

TABLE 2. MAXIMUM "TOOTH SIZE" FOR BLANKS OF OVER-SIZE PINIONS

No. of Teeth in Pinion	14½-degree Pressure Angle No. of Teeth in Mating Standard Gear				No. of Teeth in Pinion	20-degree Pressure Angle No. of Teeth in Mating Standard Gear			
	10	20	40	Rack		10	20	40	Rack
6	7	7	6 3/4	6 3/4	6	6 3/4	6 3/4	6 1/2	6 1/2
7	8 1/4	8 1/4	8	8	7	8	8	7 3/4	7 3/4
8	9 1/4	9 1/4	9	9	8	9	9	8 3/4	8 3/4
9	10 3/4	10 1/2	10 1/2	10 1/4	9	10 1/4	10	10	9 3/4
10	.....	11 1/2	11 1/2	11 1/4	10	.....	11 1/4	11	11
11	.....	12 3/4	12 3/4	12 1/2	11	.....	12 1/2	12 1/4	12
12	.....	14	13 3/4	13 3/4	12	.....	13 1/2	13 1/4	13 1/4
14	.....	16 1/2	16	15 3/4	14	.....	16	15 1/2	15 1/4
16	.....	19 3/4	18 1/4	18	16	.....	18 1/4	17 1/2	17 1/4
20	.....	.....	23	22 1/4	20	.....	.....	22 1/4	21 1/2

Machinery

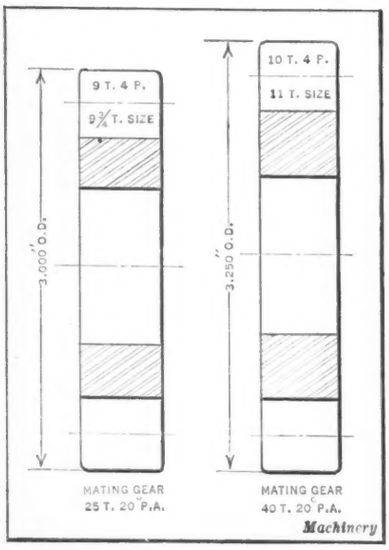


Fig. 5. Drawing for 9-tooth Pinion of 9¾ Tooth Size, and 10-tooth Pinion of 11 Tooth Size

the driven drum—the diameters of the drums being equal to the base circle diameters of the respective gears. In this analogous mechanism, it is easy to see that the torque developed on each drum is equal to the product of the tension in the rope (which is the same as the normal tooth load between the gear teeth) multiplied by the radius of the drum—the moment arm (or the radius of the base circle for a gear drive). Thus: Torque = Tooth Load × Radius of Base Circle

As the pressure angle of standard gears gives the direction of the line of action, it fixes the size of the base circle diameters of the gears, and thus the base circles of a pair of 20-degree pressure angle gears are smaller than the base circles of a similar pair of 14 1/2-degree pressure angle gears. The smaller base circle diameter of a 20-degree pressure angle gear results in a decreased moment arm, and thus a greater force will be necessary to produce the same torque as in a 14 1/2-degree pressure angle gear. A comparison of the tooth loads of a standard 20-degree pressure angle gear and a standard 14 1/2-degree pressure angle gear of the same size is given as follows:

$$\frac{\text{Tooth Load of 20 Deg.}}{\text{Tooth Load of 14 1/2 Deg.}} = \frac{\text{Moment Arm of 14 1/2 Deg.}}{\text{Moment Arm of 20 Deg.}} = \frac{\text{Cos 14 1/2 Deg.}}{\text{Cos 20 Deg.}} = 1.03$$

Therefore, the tooth loads (and also the bearing loads) of 20-degree pressure angle gears are 3 per cent greater than those of 14 1/2-degree pressure angle gears.

Effect on Base Circle Radius

The base circle radius of a pinion is not changed from standard size by cutting it from an over-size blank. This fact can be proved as follows (see Fig. 4). Triangles *ABO* and *DCO* are similar, because angle *BOA* equals angle *COD*, and angles *ABO* and *DCO* are right angles. Triangles *AB'O'* and *D'C'O'* are similar for the same reason, and remain similar with an increase in center distance between the gears. Since *AO'* and *D'O'* maintain the same ratio as *AO* and *DO* (this ratio being equal to the ratio between the number of teeth actually cut in the mating gears) *AB'* and *D'C'* will maintain the same ratio as *AB* and *DC;* and as *AB'* equals *AB*, *C'D'* equals *CD*. Hence *CD* (the base circle radius) will not change with an enlargement of the blank diameter of the pinion.

Fig. 4 shows the relative positions of the base circles of a pinion with its mating standard gear when the pressure angle is increased from 14 1/2 degrees to 20 degrees due to cutting the pinion from a blank that has been made sufficiently over-size. Since the diameter of the base circle of the pinion does not change in size, the driving force will not change for a given torque. Thus it is seen that the tooth loads and bearing loads of a pair of gears do not increase with the increase in pressure angle when the latter is due to cutting the pinion from an over-size blank.

TABLE 3. SIZES OF PINION BLANKS AND MATING GEARS—14 1/2-DEGREE PRESSURE ANGLE

No. of Teeth in Pinion	Recommended Tooth Size of Blank	Largest No. of Teeth in Mating Gear	Standard Gear of Equal Strength
7	8	12	15
8	9	16	17
9	10	22	19
9	10 1/4	40	28
10	11	32	23
10	11 1/4	56	35
11	12	50	26
11	12 1/4	76	42
11	12 1/2	Rack	75
12	13	70	32
12	13 1/4	Rack	50
12	13 1/2	Rack	150
14	15	110	42
14	15 1/2	Rack	Rack
20	21	Rack	100
20	22	Rack	Rack
26	27	Rack	Rack

Machinery

Maximum Amount Pinion Blank Can be Made Over-size

The maximum amount that a pinion blank can be made over-size is fixed by the converging of the involute curves of opposite sides of the pinion's teeth. It can be seen by comparing tooth *A*, Fig. 1, with teeth *B*, *C*, *D*, *E*, and *F* that this convergence increases as the blank diameter increases. The largest pinion blank size (this size being given as the "tooth size") that can be recommended for a given number of teeth in the pinion when it is to mesh with a 10-tooth, 20-tooth or 40-tooth standard gear or standard rack is given in Table 2.

TABLE 4. SIZES OF PINION BLANKS AND MATING GEARS—20-DEGREE PRESSURE ANGLE

No. of Teeth in Pinion	Recommended Tooth Size of Blank	Largest Mating Gear	Standard Gear of Equal Strength
6	6 3/4	12	12
7	7 3/4	20	13
8	8 3/4	35	14
9	9 3/4	60	15
10	10 3/4	Rack	17
10	11	Rack	23
11	12	Rack	26
12	13	Rack	30
12	13 1/4	Rack	40
14	15	Rack	36
14	15 1/4	Rack	48
16	17	Rack	42
16	17 1/4	Rack	60
20	21	Rack	50
20	21 1/4	Rack	75
26	27	Rack	60

Machinery

Cutting Over-size Gears

An over-size gear can be cut conveniently with the standard spur gear generating cutter used on the Fellows gear shaper. An over-size pinion can be hobbed on a hobbing machine, but only with a special hob. This special hob has the standard depth, but must be cut with a special pressure angle and with a special thickness at the pitch line to suit the particular gear with which the over-size gear must mesh. If the over-size gear is to be hobbed, the gear blank from which it is cut must be enlarged enough so that it will mesh without interference with a rack of the particular pressure angle used for the hob. An over-size gear cannot be cut with a standard formed milling cutter.

In making a working drawing or in laying out the center distance of an over-size pinion with its mating standard gear, the over-size pinion is drawn as if it were to have as many teeth in it as its "tooth size" indicated. The number of teeth, the "tooth size," and the outside diameter of the over-size pinion, together with the number of teeth and the pressure angle of the mating standard gear, must be placed on the working drawing of an over-size pinion. The depth of cut should not be given unless it is especially calculated, because in most cases it will differ slightly from the standard depth. The working drawings reproduced in Fig. 5 show the proper specifications that should accompany a 9-tooth 9 3/4-tooth-size pinion and a 10-tooth 11-tooth-size pinion, the pressure angle in each case being 20 degrees.

For the convenience of the designer in making a selection of the amount of enlargement for over-size pinions, a list of the recommended selections is given in Table 3 for 14 1/2-degree pressure angle gears, and in Table 4 for 20 degree-pressure angle gears. In these tables pinions up to and including the 11-tooth size have blank sizes that are large enough to avoid interference, but not so large as to cause excessive pointing of the teeth due to convergence of the sides. The recommended blank sizes for pinions having over 11 teeth might be larger than those listed, but since a blank enlargement of from one to two teeth would increase the strength of the pinion up to that of a large standard gear, it is considered impracticable to increase the pinion strength beyond that of its mating standard gear.

* * *

HARDENING OF INTRICATE WORK

By HENRY SIMON

The article entitled "How Dies are Hardened to Prevent Cracking," on page 818 of June MACHINERY, contained remarks that are entirely to the point, and many failures can be prevented if the pointers given there are followed. While wholly correct, however, the procedure described could be improved upon in the hardening of small and very intricate work, as well as in the hardening of certain kinds of ordinary work other than dies.

For years, the writer did the hardening of many intricate and expensive pieces, after experience had shown that the ordinary hardening methods applied by otherwise experienced toolmakers were not adequate. A gas oven of the pot type, with the pot removed, was found preferable to other types. The pieces handled were of great variety, but none of them large, the largest weighing not more than 10 or 15 pounds.

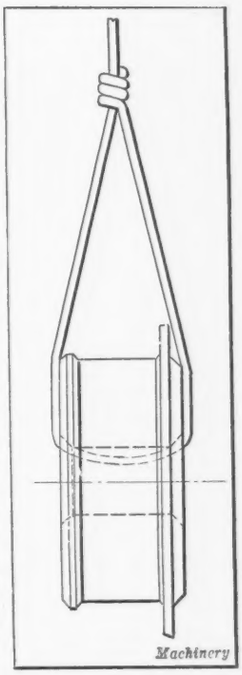
The work was suspended at the end of a wire in the center of the oven, and care was taken to so suspend it as to minimize warping during quenching. Small holes in the work were plugged with asbestos, and sharp corners, whenever practical, protected by wads of the same material held in place by fine wire. The oven was started at a black heat, with the three tangential flames just barely visible, and the temperature was raised so gradually that if any part of the work was seen to become heated even slightly faster than the remainder, it was considered to be proof of defective heating.

Considerable jockeying with the air and gas cock was required at times to start the oven off right. It was equally considered evidence of something wrong if it was necessary to turn the work (except when unusually large) while heating. In other words, the heat was so carefully adjusted and so gradually applied that it was unnecessary to move the work—something always insisted upon by toolmakers. This did not mean that the heating was excessively prolonged, for it rarely took longer than an hour to bring even the larger pieces up to the quenching point.

The pot was always kept closed with an easily removable cover, which was lifted off occasionally to observe the heat. The critical changes were carefully watched for, and on account of the even heating, could be easily distinguished. When at the proper point, the work was quickly removed, plunged into the bath, and kept moving straight up and down until the temperature was about that of boiling water. The color tempering method had been discarded long before in favor of the liquid salt bath and thermometer, and when the work arrived at the point mentioned, which would range from 200 to 250 degrees, it was instantly transferred to the tempering bath, which was ready at a temperature of about 300 degrees. This bath again was brought up to the required limit gradually, and the tempering completed by keeping the article in the bath the necessary number of minutes at the specified temperature.

Here, again, the common method of plunging the tempered work into cold water or oil was considered wrong, and instead, the work was suspended in still air, after being removed from the bath, and allowed to cool slowly to body temperature, when the remaining salt was washed off in warm water.

According to the writer's experience, the cracking of work is often not the result of uneven heating, but of faulty treating in quenching, especially in water hardening steel. As rightly emphasized in the article in June MACHINERY, it is particularly dangerous to allow the work to cool too much below the tempering temperature, and the proper moment of removal from the quenching bath and transference to the tempering bath is of the utmost importance, especially in work of a nature similar to that in the illustration, which shows a form tool made from water hardening steel having a thick and heavy body and a delicate flange. It should be added that while there seems to be an impression that such work should be suspended with the wire passing axially through the center hole, experience has shown that the way shown in the illustration is preferable. This is due to the fact that the latter method of suspension gives the steam a better chance to get away from the work than the former.



Work suspended on Wire for quenching

The system described gave uniformly excellent results with large numbers of difficult and expensive pieces over a period of years. It was also found that there seemed to be no greater danger from cracking when using brine than when using plain water. It is well to keep in mind that hardening is an art, and will remain so in spite of any science that is brought to bear upon it—and rightly brought to bear upon it. But, except for routine work such as hardening mass articles, nothing can take the place of the ultimate judgment of the experienced hardener and his sympathetic handling of each piece.

* * *

WELDED STEEL DUMP TRAILER

The accompanying illustration shows a heavy-duty dump trailer recently brought out by the Euclid Crane & Hoist Co., Euclid, Ohio. Electric welding is used in place of riveting on the frame. The dump itself is entirely welded to make it water-tight, so that the equipment may be used for the transportation of grout. The type of welded joints used throughout the construction of the equipment were developed through cooperation with the Research Department of the Lincoln Electric Co., Cleveland, Ohio, and by field service tests.

Heavy-duty Dump Trailer with Electrically Welded Joints

The Employer—His Responsibilities*

By CHARLES PIEZ, Chairman of the Link-Belt Co., Chicago, Ill., and President of the Illinois Manufacturers' Association

IN the abstract, the employer is the agent who sells the labor of his workers. The relationship is well illustrated by the remark of one of our crack mechanics. A machine on which he had been working in the shop went wrong in the field, and he was sent out to fix it. When he got back, I asked him whether he had overcome the trouble. "Oh yes," said he, "but I found out one thing I never knew before." "What is that?" I asked. "I found out that when I worked on that machine in the shop, I wasn't working for this company at all; I was working for that profane cuss down in South Bend."

While the ordinary relationship between purchaser and worker is rarely as direct at it was in this instance, it is nevertheless true that, though the employer owns the shop and equipment, though he controls the management and the policy, though he exercises the right of hiring and firing, in the final analysis, his responsibility consists of finding a market in which he can dispose of the labor of his workers. That being the case, the price he fixes for a unit of labor cannot be satisfactory to the worker alone; it must be satisfactory to the purchaser as well.

Wages are Paid by Purchasers of the Goods Manufactured

I am dwelling on this relationship merely to emphasize a truth which, in the growing complexity of modern industry, is usually lost sight of, and that is that the employer in a free and competitive market, neither fixes the rates of wages nor does he, except in an intermediate capacity, actually pay them. They are fixed and paid for by the purchasers of the commodities of which the worker's labor is a component part.

Even when the workers are organized and fix the rates of wages through the economic strength of their organizations, the purchasers still have the final decision as to whether the rates shall be paid or not, for if the rates raise the price of commodities unduly, demand lessens, and an adjustment, acceptable to the purchaser, becomes necessary. Strikes that grow out of demands for increases in wages usually develop because the employer foresees the economic effect of the increase and resists it in order to save his market. The employer's attitude toward wages, therefore, is a compromise between the expectations of the workers and the willingness of the purchaser to pay.

Failure to agree on such a compromise often results in a situation like that in the bituminous coal fields, where a considerable part of a huge industry is languishing, not because the mine operators are at fault, but because, in the open market now existing, purchasers decline to pay the advances in cost due to the union scale and rules. The tendency on the part of the uninitiated is to over-rate the responsibility of the employer, or, perhaps I should say, to under-rate the obstacles that prevent him from achieving the goal fixed by idealists.

No successful modern employer is unmindful of the fact that he is dealing with human beings and not with theoretical abstractions; nor can he fail to remember that the concerns of humanity cannot be banished from business. The development of the modern personnel departments and the growing intelligence with which the employment relationship is treated, are examples of the more humane attitude that prevails in modern industry. It is the human factor in industry that has given rise to the problems to which the science of economics has not yet found complete and satisfactory solutions.

*Abstract of an address made before the Congress of Amerian Industry at Philadelphia, Pa., September 22.

Understanding of Economic Facts is Necessary to Establish Friendly Industrial Relations

Honest differences of opinion can, therefore, quite naturally arise, but when there is intelligent appreciation of the conditions and when cool-headed counsel prevails on both sides, a mutually satisfactory agreement can be reached through sympathy and understanding. However, there must be full knowledge on the part of both employer and worker, of the ethical and economic laws that control the processes of industry, if peace and cooperation are to replace strife and discord. There must be a common basis of admitted facts and principles, if the industrial millenium is to be brought appreciably nearer.

No common ground can be found, for instance, between the employer who believes in the American constitution, the rights of private property, and the sanctity of contracts, and the agitator who advocates, as the only remedy for fancied or real industrial ills, the overthrow of the present social and economic system and the establishment of the dictatorship of the proletariat.

Wages and Production Cannot be Considered Separately

There must be appreciation of the fact that wages cannot be considered separately from production—that more cannot be taken out of the common pot than has been put into it. Basing wages on cost of living and divorcing them wholly from production, was one of the calamities of the war, for it created, in the minds of many, the delusion that industry, irrespective of output, performance, or character of service rendered by the workers, can meet their expectations as to wages.

Production is not a partnership between employer and worker alone—the consuming public is likewise a member; and while production cannot and should not disregard the conditions under which the workers live, the public, and not the employer, holds through the price it will pay, the final decision as to the scale on which the workers can live. It is true that the public is not represented in person in this trinity, but it is represented very effectually by the employer, who must satisfy the buyer as to price if he wishes to hold or extend his market.

The Employer's Responsibility

Primarily the employer's responsibility to his workers consists in providing them with steady work, under sanitary conditions, at the best possible wages. To those who are under the illusion that the employer's purse undergoes constant and automatic replenishment, that sounds like an easy task. But to those who have to meet fifty-two payrolls a year, in the face of keen competitive conditions, the responsibility is by no means a light one.

To provide continuous work and high wages, it is necessary to intensify production by equipping with better and more powerful tools, providing a greater amount of power, saving labor by increasing the application of mechanical handling, and finding methods for eliminating lost motion and waste. Above all, it is incumbent on the employer to build up, among his workers, such a spirit of confidence and cooperation that they will become important factors in that complex and highly effective organization required by large-scale industry. How to win that confidence and cooperation, how to build up that team spirit that spells success, is one of the problems for which no specific solution has yet been found. Sometimes it is developed through the personality of the owner, through his fairness and his considerate attitude toward his employes, or, perhaps, through his qualities of leadership.

In the larger organizations, it can be developed through broad and liberal policies on the part of the corporation, supplemented by the ability of specialists at the head of well organized personnel departments. Employe representation, working through shop committees and works councils that have charge of all matters relating to the employment relationship, is often a valuable aid in avoiding injustice and building up a proper esprit de corps. The success of these devices depends, however, on the character of the representation and the sympathy and consideration given by the management. They are of value in large and well organized industries. In the smaller industries, where close contact can be maintained by the employer, or by him through his superintendents and foremen, more satisfactory results can be obtained through less complex machinery.

There is No Substitute for Individual Leadership

Business needs power and authority vested in a single individual to run profitably. Leadership must exist if success is to be achieved, and no board or committee can serve as a substitute for centralized executive direction under a competent individual.

The successful man always has a big following, and the successful industry, built up and operated by its owner, rarely has labor trouble. It doesn't have to use profit sharing or other schemes to insure cooperation. Liberal wages for work performed will insure that. The workers are interested in earnings they can immediately receive in cash, not in those that are deferred for six or twelve months, or are conditioned on the continued success of the business.

The earnings of the average business are altogether too small, after a return for capital and the funds necessary for proper business expansion are set aside, to permit of a distribution that will prove a real incentive to the workers. A far better plan is to give the workers the opportunity, through intelligent effort and application, to earn wages in considerable excess of the prevailing rates. A fat pay envelope is the best preventive of discontent.

The Equitable Distribution of the Returns of Industry

The distribution of the profits of industry is the perplexing problem before employers today, and the one around which most controversies center. How much does labor contribute and how much does management? What is the proper return to capital to cover the interest on the investment as well as the financial risk?

If we could develop a generally successful formula to determine an equitable distribution, we would enter a long era of industrial peace and tranquillity. But it is impossible, so we must continue our system of barter to determine wage rates without reference to the profits of industry. And that may, after all, be best, for labor can take no chances on profits. It must be paid promptly and fully for the work it has done. Its opportunity for increases in wages will grow out of the speeding up and intensification of industrial processes, through improvement in mechanical handling and increases in the application of power.

The New Era of Management

The rise of management as a separate factor in industrial operations is the direct result of the growth, in number, of corporation-owned establishments. Ownership is no longer individual, it is collective, and no single member of the owning group may be qualified to assume direction of affairs. The responsibility for successful operation is, therefore, vested in an individual or group who are rarely heavily interested in the stock of the enterprise, but who have special experience in the production, technical, administrative, financial, and selling side of the industry. As a rule, they are on a salary basis, supplemented by a share of the profits, and while they have no great investment at stake, they do risk their reputations and their earning capacity in the case of failure. As to the owner's share in the distribution, he takes what is left. Whether that is too little or too much depends upon circumstances that are usually not within his control.

How Profitable is the Average Business?

Because of the substantial profits by a few, it is popularly supposed that all industries are highly profitable. As a matter of fact, operating an industry is a hazardous undertaking, with a high percentage of financial mortality. On the average, 37 per cent of the 80,000 or more corporations engaged in manufacturing, report deficits of considerable amounts, and 63 per cent report profits. In the critical year of 1921, only 46 per cent reported profits, and 54 per cent reported deficits in excess of the gains, so that manufacturing for 1921 showed a deficit of over $100,000,000. The popular fallacy that the average industry is exceptionally profitable, is not borne out by the United States Treasury reports, and the owners of industry must not, on that account, be expected to assume a heavier burden than they are able to carry.

Knowledge of the facts concerning industry is growing, fallacies and wilful misrepresentations concerning industry are less frequently encountered. Labor is going into business and is getting first-hand information as to the conditions that prevail, and the economic laws that govern it. Employers are taking a greater interest in labor conditions, and appreciate that low costs are not inconsistent with high wages. The millenium is not yet in sight, but days of better understanding are near. When they arrive, there will be a comfortable lessening of the responsibilities of the employer.

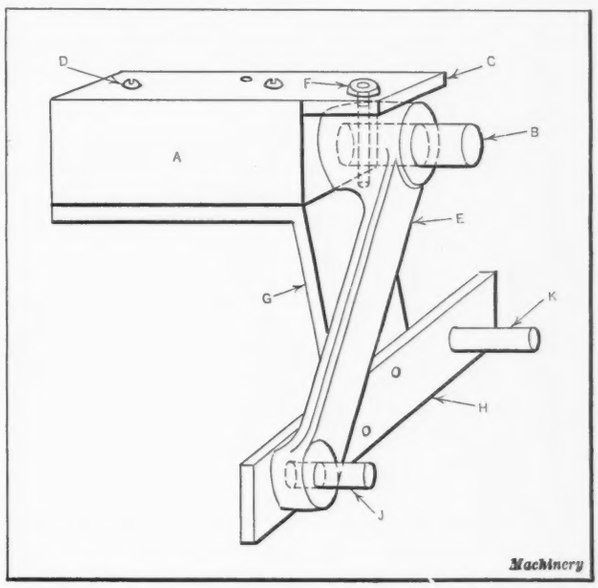
* * *

DRILL JIG FOR BRAKE LEVERS

By H. C. TEN HORN

In the accompanying illustration, is shown a simple drill jig which proved very satisfactory for drilling both right- and left-hand brake levers. The iron piece *A* is provided with a taper pin *B* which fits the hole in the large end of the lever *E* to be drilled. The strip *C* is attached to block *A* by dowel-pins and screws *D*. A hardened steel bushing *F* is mounted in plate *C* to guide the drill when drilling the hole through the large end of the brake lever hub.

The strip *G*, which is bolted to the under side of piece *A*, is bent downward, and has an arm *H* riveted to it at its lower end. The two pins *J* and *K* are located at the proper positions for locating the small end of the lever. For performing the operation, the body of jig *A* is held in an ordinary drill press vise. The operator simply places the lever in position on the locating pins *B* and *J*, with the inner faces of the hubs in contact with the jig members *A* and *H*. The hole is then drilled in the usual manner. To drill a left-hand lever, the hole in the small end of the lever is placed on the pin *K* instead of on pin *J*.



Drill Jig for Right- and Left-hand Levers

EXPANSION BENDS

For low-pressure steam and exhaust mains, expansion joints of any suitable standard make may be used to take up or relieve the strains on a piping system, but for high-pressure steam mains, it is customary and advisable to use expansion pipe bends made up of full-weight or extra-heavy steel or wrought-iron pipe. When the steam main is of considerable length, it is advisable to divide the expansion between different sections of the piping system, anchor the main rigidly at a point near the middle of each section, and provide an expansion bend in each section. The amount of expansion that can be taken care of by an expansion bend of wrought-iron or steel pipe depends upon the shape of the bend, the mean radius of the bend, the outside diameter of the pipe from which the bend is made, and the amount of straight pipe allowed between the arcs or curved portions of the bend.

NICKEL

Nickel is a grayish-white, malleable, ductile metal. In dry air, it remains unchanged, but oxidizes slowly in moisture in which acids are present. It resists the action of caustic soda, caustic potash, and concentrated nitric acid, but is readily dissolved by dilute nitric acid and aqua regia. Dilute hydrochloric acid and dilute sulphuric acid attack it very slowly. Nickel is used to a very large extent in the industries, especially in the manufacture of domestic utensils and for nickel-plating; it is also used for coins, and a number of alloys. Steels containing a small percentage of nickel have properties far superior to those of ordinary steel, while steels containing a very high percentage of nickel have been manufactured for special purposes. Nickel is obtained mainly from garnierite, the largest deposit of which is in New Caledonia, and from pyrrhotite, which is found principally in Canada, Germany, Sweden, and Norway. It is also secured from the by-products obtained by treating many pyrite and chalcopyrite deposits for sulphur or copper. The method of extracting the nickel depends upon the composition of the ore.

The specific gravity of nickel varies according to the method used for obtaining the metal; it has been found to be as low as 8.3 and as high as 9.25; an average commercial value is 8.8, giving a weight per cubic inch of 0.318 pound. Pure nickel melts at 1452 degrees C. (2646 degrees F.). The melting point of commercial nickel, however, varies anywhere from 1400 to 1600 degrees C. (from about 2550 to 2900 degrees F.). The specific heat averages 0.108 between 60 and 212 degrees F., and increases with an increase in the temperature. The thermal conductivity of nickel equals 14.2 (silver = 100) and the electrical conductivity, 12.9 (silver = 100). The linear expansion per unit length, per degree F., equals 0.00000695. Nickel is magnetic, but loses its magnetism when heated, and becomes entirely non-magnetic at a temperature of about 650 degrees F.

CONDENSATION

The loss due to cylinder condensation in steam engines is the most serious of all losses, and is caused by the chilling effect of the cylinder walls upon the entering steam. There are three methods of reducing the condensation loss: First, by increasing the horsepower rating by the use of higher speeds and pressure and later cut-off of the steam; second, by using superheated steam which must be cooled to the saturation point before condensation can occur; third, by multiple expansion in the engine or turbine, the expansion being distributed consecutively among two or more cylinders which progressively increase in size.

PLATINUM

Platinum is a grayish-white metal which is very malleable and ductile. This is one of the heavier metals, having a specific gravity varying from 20.85 to 22.6, according to the treatment it has received. It melts at a temperature of 1755 degrees C. (3190 degrees F.). Its linear expansion per unit length, per degree F., equals 0.00000479. Its electrical conductivity (silver = 100) is about 14.4. Its mean specific heat, from 32 to 212 degrees F., is 0.0323. Its latent heat of fusion is 27.18 calories. The atomic weight is 195.2.

BOOSTERS

A booster is a generator inserted in series in a circuit to change its voltage. It is generally driven by an electric motor and may be either of alternating or direct current. Alternating-current boosters are mostly used in connection with synchronous-booster converters, and to a certain extent in connection with transmission systems for controlling the voltage of different plants that are operating in parallel on the same system. Direct-current boosters are used in railway stations to raise the potential of the feeders extending to distant points of the system, and also for storage battery charging and regulation. Where there are a number of lighting feeders connected that run at full load for only a short time each day, it will generally be found economical to install boosters rather than to invest in additional feeder copper. Boosters may be non-automatic or automatic in their variation of voltage. The former are used generally for charging batteries, and occasionally for assisting battery discharge, while the latter are used for line-drop compensation and for the purpose of causing instantaneous charge and discharge of a battery on systems supplying energy to loads that fluctuate widely and rapidly in the power demand. Boosters may also be classified as reversible and non-reversible, depending upon whether the current passes through the booster armature in either direction, as for charging or discharging of a battery, or whether it passes in one direction only, continuously through the armature. Boosters may furthermore be self-excited or separately excited, and shunt, series, compound or differential wound.

MANGANESE

Manganese is one of the most important of the minor metals. The ores are obtained from many parts of the world, including the United States, Brazil, France, Germany, and India. Manganese is used extensively in the iron industries in the manufacture of iron-manganese alloys, such as spiegeleisen, ferro-manganese, silver spiegel, and silico-manganese. Spiegeleisen and ferro-manganese are used largely in the manufacture of steel, as reducing agents and recarburizers. A considerable quantity of high-grade manganese ore is also used as a depolarizer in the manufacture of dry-cell electric batteries. Manganese steels have many important qualities not found in other steels. Manganese-bronze is produced by alloying manganese with copper, while so-called "silver-bronze" is obtained by alloying manganese with aluminum, zinc, and copper. Oxides of manganese are used in glass manufacture, and as dryers of varnishes and paints. Manganese is also used as a coloring material for staining glass, tiles, and bricks, as well as in calico printing and dyeing. The specific gravity of manganese is 7.42, making the weight per cubic inch, 0.268 pound. The specific heat at 32 degrees F. is 0.122; the melting point of manganese is 1225 degrees C. (2237 degrees F.). Its electrical conductivity is 15.75, that of silver being taken as 100. Manganese is a metal having a close resemblance to iron in many respects.

Oxy-acetylene Welding of Copper

By A. EYLES

THE modern art of autogenous welding with the oxy-acetylene torch provides a means of effecting welds on copper products that some years ago was impossible; in fact, this process makes it possible to obtain perfect and homogeneous copper welds. The art of welding copper is popularly supposed to be a process of much difficulty. True, the process is one that requires skill and considerable practice before absolutely and consistently reliable results can be obtained, because the metal has peculiar characteristics which involve a somewhat different method from that required for iron, mild steel, and other metals. However, this method is not difficult to acquire, for copper is readily welded by the oxy-acetylene process.

In the welding of copper, certain precautions are necessary, since the metal has a great affinity for oxygen, and, when molten, for hydrogen. The oxygen unites with the copper to form an oxide, and in the case of molten copper, this oxide is absorbed in the molten mass. Upon cooling, part of the oxide reforms, with detrimental effect on the strength of the metal. Further, in the event of oxygen, hydrogen, and carbon monoxide being absorbed during the welding operation, these gases will surely be evolved as the metal cools, making the weld porous and very weak. Another peculiarity of copper is its brittleness at a temperature somewhat above a dull red color (1475 to 1550 degrees F.). The operator must, therefore, be careful to guard against contraction strains as the metal cools down.

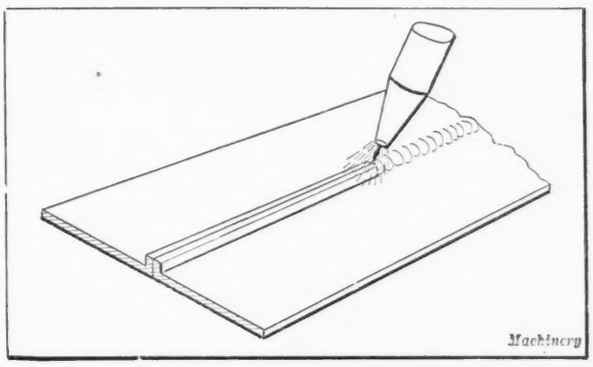


Fig. 1. Flanging Edges of Thin Copper Sheets preparatory to welding

Use of Fluxes Unnecessary

Although fluxes are generally used in the welding of copper, recent results have demonstrated that these substances are of no value. A perfectly regulated torch, exercising a sufficient protective and deoxidizing action, not only protects the molten metal from oxidation by contact with the air, but even reduces any oxide that may be present. It is possible to obtain a good strong weld in copper by using a welding rod consisting solely of very pure copper; however, a trace of phosphorus (not exceeding 1 per cent) may be advantageously incorporated in the welding rod.

When phosphorus is used as a deoxidizer, the slag formed is very fluid and rises to the surface of the molten metal, thereby preventing further oxidation and retarding the absorption of gases. A point of some importance, however, is the undesirability of allowing phosphorus to become permanently incorporated in the finished weld, since this would have a tendency to make the metal brittle; hence a high phosphorus content in a copper weld must be rigidly guarded against. Special copper welding rods and fluxes should be obtained from concerns that are specialists in oxy-acetylene welding.

The fluxes commonly used in copper welding are either sodium borate or a mixture of sodium borate (anhydrous) and boric acid, sometimes with the addition of sodium chloride to lower the melting point of the flux. The following reactions probably take place: The sodium borate and the boric acid at high temperature yield boric anhydride, a vitreous mass, soluble in water, forming boric acid. The boric anhydride combines with the oxide of copper, forming copper borate. The melting point of this borate is fairly high, and the addition of the sodium chloride has been found to bring the melting point lower than that of the copper itself; as a deoxidizer, small quantities of phosphorus are sometimes included in the flux.

Preparing the Copper for Welding

In preparing the copper to be welded, it is first necessary that the edges of the metal to be joined and the areas near the welds should be absolutely clean. When copper is clean, it is much more likely to make a good strong weld than when impurities are present. Scale, grease, and foreign matter will contaminate the weld, and such inclusions will necessarily make the metal porous and spongy and may prevent the molten metal from filling all parts of the weld, causing cavities or blow-holes and seriously reducing the strength of the welded metal. There are various methods of cleaning, including pickling (in sulphuric and nitric acid solutions), scraping, filing, machining, sand-blasting, etc. The essential point is to remove, as perfectly as possible, all impurities from the vicinity of the weld.

In welding thin sections or sheets 1/16 inch thick and under, the edges should be flanged to an angle of 90 degrees to a depth of one to one and a half times the thickness of the metal, varying with the thickness (see Fig. 1). With this method, the customary welding rod is unnecessary, the edges being fused and providing the necessary material for the weld. The two lower flanged edges should be adjusted so that they touch exactly. Sometimes it is advisable to tack the flanged pieces together by fusing the edges of the flanges at intervals of from 3 to 6 inches before melting down the whole flange. One of the precautions in making flange welds is to secure complete penetration to the bottom (or to a suffi-

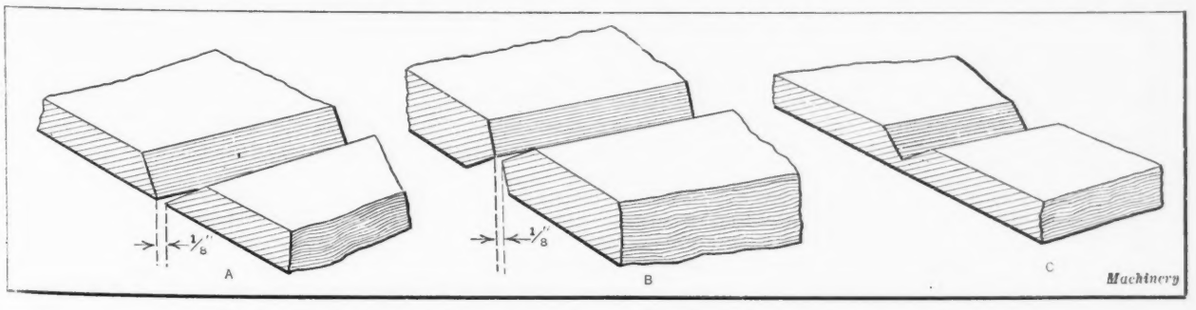


Fig. 2. Methods of beveling Edges of Comparatively Thick Copper Sheets preparatory to welding

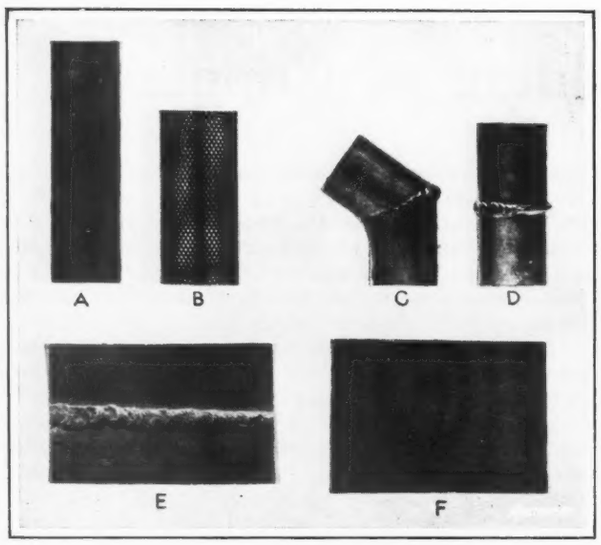


Fig. 3. Some Examples of Copper Welding

cient depth to assure a good weld) and to eliminate the oxide film that is likely to exist between the flanged edges.

When copper sections or sheets are from 1/16 to 1/8 inch thick, the edges may be simply butted together. Above 1/8 inch in thickness, the edges should be beveled to an angle of 45 degrees, so as to obtain a vee having an angle of 90 degrees (see diagram *A*, Fig. 2). The bottom edges should be set about 1/8 inch apart. For sections over 1/2 inch thick it is better, when possible, to weld on both sides and to have both faces beveled, the angle of each open side being at least 90 degrees (see diagram *B*, Fig. 2). In the case of cracks that do not penetrate through the full thickness of the metal, the beveling should extend right to the bottom of the crack (see diagram *C*, Fig. 2), and the bottom of the groove should be thoroughly cleaned out with suitable tools to remove the last trace of impurities.

The careful adjustment of the parts and retaining them in their correct position is necessary; in production welding and repair work, various jigs and fixtures can be devised for this purpose. The judicious use of jigs, often of the simplest design, will make it possible to overcome distortion in the finished product. In production welding and repair work, preparation of the work is a very important feature, since it will save considerable time and keep the cost of welding low.

The Torch and Flame Adjustment

To successfully weld copper, it is essential to use the right size of torch tip for the thickness of metal to be welded. A torch of inadequate power produces the defects of adhesion, as also does the use of a torch of excess power. The size or power of a torch is denoted by the number of cubic feet of acetylene consumed per hour when the flame is correctly adjusted or regulated. This quantity is sometimes marked on the torch, or if not, it can be determined from data supplied by manufacturers of oxy-acetylene welding equipment.

Good copper welds can be obtained only if the torch will constantly maintain a neutral flame; therefore, the torch must be designed and constructed so that acetylene and oxygen will be delivered at constant pressure and in constant volumes. The acetylene and oxygen valves must be arranged so their adjustment will not change, in order that the character and temperature of the flame will not vary as welding proceeds. It is of the utmost importance that the welding torches should withstand without any appreciable ill effects, the marked heating they undergo when welding heavy copper sections, and that they should not be liable to back-firing. When back-firing occurs, small particles of molten copper are blown on the operator, who is sometimes compelled to lift the torch; this should be avoided as far as possible.

The torch should be manipulated in a vertical direction so that the molten copper and the adjacent areas are protected by the outer enveloping cone of the flame. This method prevents oxidation, and, if the flame is truly neutral, it will minimize the absorption of gases from the flame. The flame adjustment should be the same as for steel, but a larger tip and flame should be employed for copper than for steel of the same thickness, owing to the greater heat conductivity of copper. Tips one or two sizes larger than used on steel of equivalent thickness are recommended. The tip of the inner cone of the flame should be held 1/8 to 1/4 inch from the molten metal.

Copper melts at a temperature of about 1985 degrees F., and less concentration of heat is required than for welding iron or steel. Asbestos sheets or other suitable insulating material may advantageously be used under the lines of welding. Preheating is necessary when welding large copper sections, and is desirable in order to save gas and reduce the time required for welding. When practicable, the gasoline or oil torch should be used for preheating as it is too expensive to use the welding torch. Copper welding requires promptness in execution and should be continuous, taking care to secure a complete union between the edges. It is best to add sufficient metal so that the work can be hammered flush with the remainder of the sheet or plate.

A welded copper joint is composed of cast copper, and therefore has the strength only of cast copper, but its tenacity can be increased by cold hammering over the area of the weld. After the hammering operation, heat-treatment (annealing) is essential for a suitable interval (usually for about half an hour) at a temperature of about 1300 degrees F. This treatment relieves the strains often set up within the metal during the process of welding, and restores the homogeneity of the structure. When correct methods and precautions are applied and observed, copper welds are equal in quality to the original metal.

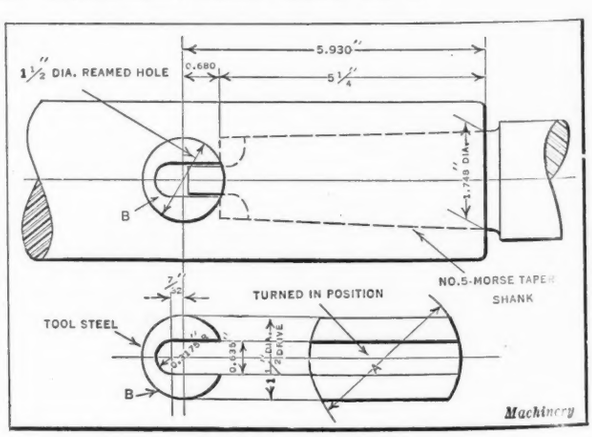
Several examples of copper welding are shown in Fig. 3. The copper pipe shown at *A* was welded by first flanging the edges, as previously explained in connection with Fig. 1. The seam was hammered after the welding operation, so that it is almost imperceptible. The copper perforated cylinder *B* also has a welded seam produced by flanging the edges and hammering after the welding process. The 45-degree copper elbow at *C* is an example of butt-welding. The pipe at *D* is only partly welded, in order to show the appearance of the flanged edges prior to the welding operation. The sheet at *E*, which is 1/32 inch thick, represents a good example of flange welding. Sheet *F* illustrates how a seam is made practically invisible by hammering.

* * *

REPAIRING WORN TANG DRIVE

By C. W. PUTNAM

In reconditioning some machinery and equipment, a novel method was suggested for repairing the worn out tang drive on taper-shank drills and other small tools. The accompanying illustration shows how the idea was applied in repairing a No. 5 Morse taper-tang drive. Other tapered-shank drives were dealt with in a similar manner, the smaller tapers having proportionately smaller slotted pins *B*.



Repaired Tang of Taper Shank

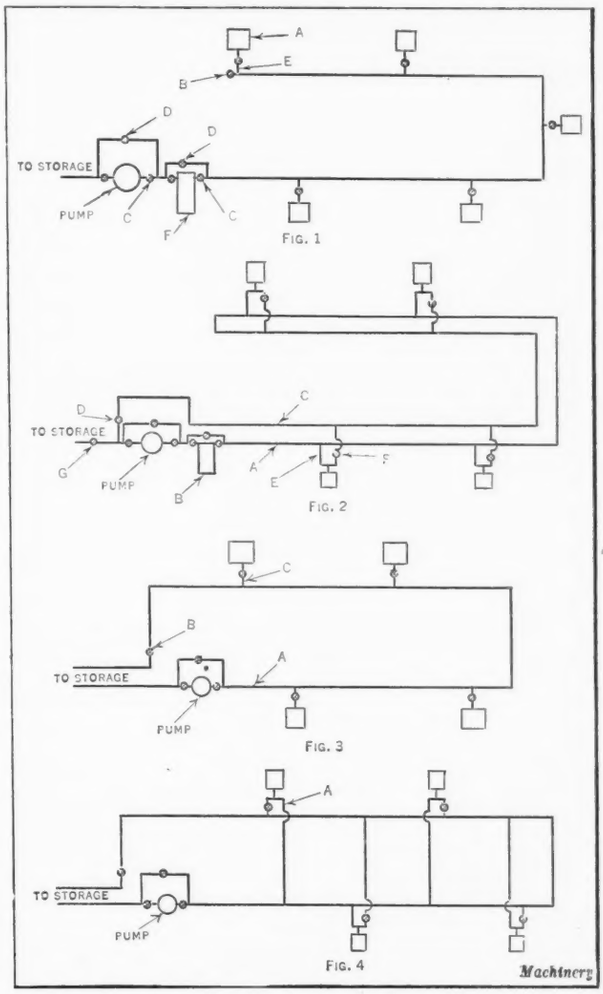
Piping Systems for Oil-burning Furnaces

By C. C. HERMANN

MANY a manager has arrived at the conclusion that the solution of his heating problems lies in the adoption of fuel oil, only to discover later that considerable time is lost out of each working day due to various oil troubles, burner troubles, and furnace troubles. From fifteen minutes to an hour is spent each morning and afternoon waiting for the oil pressure to build up, waiting for air, or adjusting the burner to meet a changed condition of delivery of fuel. The furnaces work along very nicely for a time, and then begin to spit and sputter—a dirty red flame one minute and a high temperature flame the next. The direct result is that fuel oil burning is considered far from being a reliable system; however, its use is continued rather than revert to the old coke forge with its many disadvantages.

In nine cases out of every dozen, the drop in enthusiasm over liquid fuel for industrial uses is traceable directly to the design of the distribution system, as there is a vast difference in the manner in which the piping is laid and the effect such pressure producing means has on the system. A few years ago recirculation of the oil in the distribution system was little thought of; but today, recirculation constitutes one of the most important phases of fuel oil distribution. With the advent of heavier oil available to industry for process purposes, the old system, generally known as the dead-end system of distribution, comprises a dismal failure. Analyzing, therefore, the average complaint of a given industry using present-day oils, it is generally found that the entire trouble is due to lack of recirculation of the oil.

The importance of recirculation is probably best appreciated from an examination of the diagrammatic systems. That shown in Fig. 1 is known as the dead-end system, while that in Fig. 2 is the recirculating system. In Fig. 3 is shown another system, which constitutes a middle ground between the two. Referring to Fig. 1, dead ends are noticeable at each furnace, and all the oil pumped into the system must pass through the burners. Obviously, the heavy substance contained in the oil will settle to the bottom of the pipe. A by-pass placed about the pump contains a valve that may be "cracked" or opened sufficiently to maintain the desired pressure in the system. Eventually, the far end of the pipe becomes clogged up with the heavy residue, which passes through in spite of the usual care given to screening the oil, and then operation of the furnace at *A* will be impossible. The filling up continues until the next and then the following furnace also become sluggish in action.



Figs. 1 to 4. Four Piping Systems for Oil-burning Furnaces

In order to return the systems to operative condition, a steam connection is generally placed at *B*, and valves *C* at the pump are closed. Then with the by-pass valve *D* open, the system is blown out, the heavy material finding its way back to the storage tank, together with the condensed steam. This introduces water into the storage tank which is objectionable, but to eject the oil into the waste is even more so; consequently, the water thus thrown into the storage tank is removed via the storage tank pump, which is installed for the purpose of removing the water and otherwise cleaning out the tank at given intervals.

The main pipe is thus easily cleaned of all heavy residue, silt, and sand carried over by the oil. The short leads *E* from the main distribution line to the furnace, however, remain in their plugged up condition unless a steam line is attached at the burner of each furnace. Obviously, this would take considerable time. In general, therefore, the blowing out is confined to the main line, and the furnace trouble is only partly cured. The inefficiency of operation continues on a somewhat reduced scale.

The dead-end system possesses another serious objection. The work of the heater *F* is practically nullified, due to the reduced velocity of the oil in the distribution pipe. In the immediate vicinity of the heater, the temperature of the oil is maintained at the desired point. The transfer of heat along the line of oil is much slower than the radiation, and the furnaces located a short distance away from the heater must operate on practically cold oil.

An examination of Fig. 2 shows how these objectionable features of the dead-end system have been eliminated by the utilization of recirculation of the oil. The oil is drawn from the storage and pumped into the supply line *A*, after passing through the heater *B*, and it returns by the return line *C*. This return is provided with a valve *D*, which is cracked sufficiently to maintain the desired pressure in the system. The oil in the main pipe is moving constantly, eliminating the tendency for the heavy residue to settle in the bottom of the pipe. Should the return plug up slightly, the pump would build up a pressure sufficient to clear the obstruction. Likewise oil of the desired temperature is being moved constantly throughout the entire system.

To eliminate the dead ends at the furnace burners, a loop *E* is produced. This loop is connected at one end with the outgoing line, and the opposite end with the return which flows in the reverse direction beside the former line. A valve *F* is located in the return end of the loop in order to regulate

the flow past the burner and maintain the desired pressure at the burner. Oil will be circulating past the burner constantly, eliminating the possibility of this portion of the system filling up with heavy residue.

The return oil, say, at the point of the valve *D*, contains a considerable amount of heat which would be lost should it be directed back to the storage tank. In order to utilize the maximum amount of heat, the return is introduced into the pump suction line and passed through the system again. The suction line is provided with a check valve at *G* so that the velocity energy of the return fluid is also saved, the pump drawing such make-up from the storage tank as is determined by consumption. In order to measure the consumption of this system, it is necessary to place the meter in the suction line between the valve *G* and the storage. An oil temperature of approximately 125 degrees is maintained. There will be some heat loss along the distribution lines, and in order to compensate for this loss, it is general practice to parallel the distribution lines with a steam line, and incorporate the three pipes in a common insulation.

Fig. 3 shows the semi-recirculating system. The main distribution pipe *A* is fully recirculating, the return being introduced direct into the storage tank through the valve *B*, which is cracked sufficiently to produce the desired pressure in the main. The furnace leads *C*, however, are not recirculating. These leads are merely taken off the main pipe, and end at the furnace burner, and they are therefore dead ends.

Fig. 4 illustrates a piping system designed by the writer several years ago, which incorporates some of the essential characteristics of the one illustrated in Fig. 2, relative to recirculation. The principal difference is that the return pipe leads back to the storage; this arrangement was adopted because the heating coils were located in the storage. It will be noted that the existence of pipe friction is taken advantage of in order to obtain recirculation in the furnace loops *A*. A valve is incorporated in each loop to regulate the pressure at the furnace burner.

The amount of piping utilized in a given system often constitutes a determining factor in the design. Fig. 4 shows how the recirculating element can be obtained quite often with less pipe than that shown in Fig. 2. By connecting the end of the return into the suction of the pump, the velocity energy of the moving oil is readily conserved. A check valve would, of course, be incorporated between this connection and the storage tank.

It is advisable to incorporate steam connections in the lines at various points, in order to clean out the pipes occasionally. With the grade of oil now available, it may be necessary to clean the pipes at least daily. At any rate, the system should be drained daily. To allow the oil to remain in the pipes over night, invites morning starting troubles. The necessary by-pass or auxiliary pump connections should be supplied to enable the oil to be drawn from the distribution lines at the end of the day and returned to the tank; then a quantity of steam is injected for the purpose of cleansing the pipes.

* * *

SOUTH INVITES MACHINE SHOP INDUSTRY

The New Orleans Association of Commerce is distributing a booklet entitled "Industrial New Orleans," containing information regarding New Orleans as a manufacturing city. New Orleans is considered by the association a suitable center for machine shops and steel plants.

COST SYSTEM FOR SMALL SHOP

By WILLIAM F. SANDMANN

In the majority of cases, the failure of a small shop can be directly attributed to a single cause, namely, the lack of a system of some kind for ascertaining job costs. A great deal has been published on the subject of costs, but the man operating the small shop does not have the time to go deeply into this subject, and the volume of his business does not warrant the expense of a clerical force capable of maintaining an intricate cost accounting system. The cost system for the small shop must necessarily be simple, easy to take care of, and designed to show, without a maze of figures, if a job is finished at a profit or a loss.

In an Indiana tool shop employing ten men, with an office force consisting of the owner and an office girl, a very simple job cost system has been developed which gives all the information required. In Fig. 1 is shown a time card used by the employes, which does not require the use of a time-clock. The card is divided into twelve spaces representing twelve working hours, and each space is divided into ten six-minute periods, so that the decimal system of time addition may be used. The card illustrated shows that John Smith began work at 7 o'clock in the morning on job No. 312, and completed the work at 9:36, making a total of 2.7 hours. He then started work on job No. 321, and worked until 4:24, with an hour out for lunch, after which he returned to finish job No. 312, working until quitting time at 5:30.

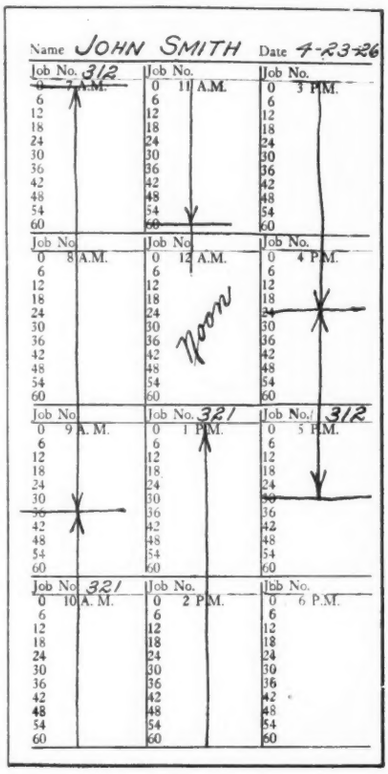


Fig. 1. Time Card kept by Employe

The reverse side of the card, on which the employe marks down the amount and kind of material he uses on each job, is shown in Fig. 2. The cost of the material is computed when the card reaches the office. On the bottom of the card, the office girl enters the total number of hours worked on each job, and adds these together to obtain the total number of hours worked for the day. The total number of hours is, of course, entered in a regular time book such as every employer keeps.

The number of hours spent on a job and the material used are entered on the sheet shown in Fig. 3, which is known as a "job sheet." This sheet is shown made out for job No. 312, and a sheet is kept for each job number that enters the plant. The name of the job and the name of the customer are entered at the top of the job sheet.

The time card shows that J. Smith worked 3.7 hours on April 23 on this job, and this is entered, together with his hourly rate of 65 cents, and the total cost—$2.41—for the labor. The material and material costs are entered in the lower left-hand corner. When the job is finished and ready to be billed, the hours of labor are added up and the total labor cost computed. These values are then entered in the lower right-hand corner as shown. The labor cost, with the overhead and material cost added, give the total cost of the job, and this subtracted from the selling price gives the profit, or in case the job is done at a loss, the selling price subtracted from the total cost of the job will show the loss. In the case of the job sheet shown in the illustration, the profit is 35 per cent of the selling price. It is a good thing to put this percentage down, so that a number of sheets can be glanced over and the percentage of average profit mentally estimated.

It may be well at this time to call attention to the overhead rate. This rate should be refigured each month, and the rate thus established for the following month. The items that go to make up the overhead are: Wages and salaries not charged against any specific job number; rent, water,

Wiley Cylinder Service Company
Marion, Indiana

Material for Job:

#312 - 12# 1" round cold rolled .40
2 - 3/8" x 2" fill. head screws .06
$.46

Remarks:

#312 - 3.7 hrs. labor
#321 - 5.8 " "
9.5 " " Total

OK
R.W

Fig. 2. Reverse Side of Card shown in Fig. 1

heat, power, and similar items; losses on jobs that have been sold for less than cost during the month, and any expenditures not listed in the foregoing. In short, all money not paid out for wages or materials should, in general, be classed as overhead for the month. In setting the overhead cost, the total number of hours of productive labor should be used as the divisor, and the quotient thereby obtained should be used as the hourly overhead rate for the following month. This system will automatically average itself over the course of a year, and will be found accurate enough for practical purposes.

The overhead rate on the job sheet illustrated was fixed at 48 cents per hour, because the operating expenses of this particular shop for the previous month amounted to $1060.80, and the total number of hours was 2210, the division giving 48 cents as the rate. In small shops, this system is found simple, efficient, and well worth the small amount of time required each day to keep it up. Whenever money is lost on a job, the fact will be indicated immediately, so that the owner can take steps at once to prevent further losses on similar jobs.

* * *

INVESTIGATING GRINDING WHEEL ACCIDENTS

In the August number of *Grits and Grinds*, published by the Norton Co., Worcester, Mass., Mr. Rousseau, a member of the Norton Co.'s sales engineering department, points out the importance of obtaining and recording all possible related information as soon after the bursting of a grinding wheel as possible. The following should be of assistance to the investigator by suggesting to him some of the more important things to find out and report.

Grinding Wheel—Was the right wheel used for the job?

Was wheel inspected before mounting?

Did bushing protrude beyond sides of wheel?

Was wheel very cold when put into use?

Did wheel run true when started?

As far as possible all pieces of the wheel should be saved, as the character of the fractures and other marks on the wheel are sometimes of assistance to an experienced investigator.

Grinding Machine—Was machine in good condition?

Were bearings or spindle worn?

Was any vibration noticeable previous to breakage?

Were relieved flanges of correct dimensions being used?

Were both flanges in good condition, or had one or both become worn or sprung out of shape?

Was inner flange keyed or otherwise secured to spindle?

Mounting—Were blotters or other cushions used between wheel and flanges?

Did wheel slide on arbor easily when mounted, or was it necessary to force it into place?

Did wheel bear evenly against inner flange?

What means were used for tightening flanges?

Was excessive pressure used?

Operation—What was actual speed of wheel? This should be checked by actual test.

Was considerable heat generated during grinding?

How was work applied to wheel? Was excessive pressure used?

Was any grinding being done on sides of wheel?

Was it possible that anything heavy struck the wheel either while running or while at rest?

Did a piece of work or any other object become wedged between wheel and work-rest or any other part of machine?

General—How long had wheel been running when breakage occurred? (This refers to time since last starting.)

How long had wheel been at rest, previous to last starting?

Could anything have happened to it during this time?

The importance of checking this information as soon as possible after the accident, is emphasized, for a delay might mean the loss of opportunity to obtain answers to the most important questions. Answers to all questions relative to the case should be obtained by actual investigation and careful questioning of everyone concerned. Although the conditions referred to might be supposed to be correct, and might have been so according to latest records, an investigation sometimes shows that one or more of these conditions are sometimes altered, either intentionally or otherwise, without anyone in authority being aware of it.

Occasionally a wheel of improper specifications is substituted. Sometimes the outer flange is misplaced and a smaller one or even a washer is used instead. Not infrequently speeds of main lines are changed without changing the pulleys that drive the grinder. A special set-up for an odd job is occasionally made, and makeshift equipment is used. The quality of metal in the work may have been altered, or a new man not entirely familiar with the work may have been employed.

Job No. 312 MILLING FIXTURE FOR STEP BRACKET
For JACKSON MOTOR CO.

Date	Employee	Rate	Hrs.	Cost
4-23	J. SMITH	.65	3.7	2.41
4-23	F. BROWN	.40	9.0	3.60
4-24	J. SMITH	.65	5.0	3.25
4-24	F. BROWN	.40	3.0	1.20
4-26	J. SMITH	.65	2.4	1.56
4-26	R. STONE	.80	4.0	3.20
			27.1	$15.22

Date	MATERIAL	Cost
3-23	CASTING - 50# @ .05¢	2.50
3-23	COLD ROLLED	.40
3-23	SCREWS	.06
3-24	COLD ROLLED	1.20
		$4.16

Total Hours	27.1	
Actual Labor		$15.22
Overhead $.48 rate		13.01
Total Labor Cost		28.23
Material		4.16
Grand Total		$32.39
Selling Price		$50.00
Cost		32.39
Profit (35%)		$17.61

Fig. 3. Job Sheet which shows at a Glance the Profit or Loss on a Job

What MACHINERY'S Readers Think

Contributions to this Page are Paid for at Regular Space Rates

THE SHORTAGE OF EXECUTIVES

In September MACHINERY, J. H. Wickman concludes that "in regard to this so-called executive shortage, actually there is no shortage and never has been." If there is no shortage, where can executives be found? It is easy to find machinists, and it is easy to secure apprentices to train as machinists; but several years ago I gave up trying to hire an executive to take charge of my machine shop, substituting the plan of training a boy for the position. So far, however, every boy has rejected the preparation for an executive position in favor of that of machinist, draftsman, or similar work.

One reason probably is that an executive must be competent in a number of unrelated ways. A machinist only needs to be skilled with his tools. There are many men who are good in one respect; less who are good in two different respects; but the all-around man who is even fairly good in all the varied sides of executive work is hard to find.

The executive in a machine shop should be at least a fairly good machinist. He must be a good enough accountant to understand costs and appreciate the various elusive expenses. He must understand men and be able to cooperate with them. He must be of sufficiently good character to command the respect of the men; and he must have pride in the other person's work. A failure in any one respect is enough to disqualify him, regardless of his ability in the others.

The last-named quality is the one that probably prevents more machinists from becoming executives than any other. The skilled toolmaker takes a pride in doing his work just right, and it disturbs him to have anyone else touch it. It even troubles him to have another toolmaker finish it up just as well as he would have, but differently. This quality is of the greatest value to the real craftsman, but is fatal to the executive, whose pride must usually be in work far inferior to what he could do himself.

There is a conflict between those who say there is a shortage of executives and those who say there is a surplus. Possibly the reason is that the excess is found by those who see so many men with qualities needed by executives. The shortage is found by those who demand that the necessary qualities be found in the same man. Possibly both may be wrong in their attitude. A successful owner of a business recently stated that every one of his department heads was seriously defective in some respect, but that he had decided that the best policy was to take men as they are, to use them for what they were best able to do, and to adjust their difficulties himself. His success is one argument for his method. But should these defective subordinates be classed as executives, even though they hold executive positions? It might be more correct to say that he was the only executive in the organization. Without him the business might have a hard time.

A. W. FORBES

A COMBINATION BENCH MACHINE

Judging by the great number of reliable companies advertising bench machines for precision and model work, it is evident that there is a wide demand for this type of machine. There are many cases where a small amount of model work of a precision character has to be done, but where the variety of work may be very great. In other words, a man is likely to perform many different operations in connection with work of this kind, and a combination machine would be very useful to him. There are also many men who have a shop in the basement of their home or in their garage in which they would like to have a machine that they could employ for a variety of precision work.

The writer is not a believer in a machine tool with many combinations, some of which are misfits and not capable of doing any one thing well, but from the advertisements of milling and other attachments for bench lathes, it would seem that there might be a need for a combination bench lathe and milling machine. The milling machine table would be on the outside end of the headstock of the lathe. A spindle would be provided that would furnish the drive both for the lathe and for the milling machine.

If I were designing such a machine, I would use Timken bearings on the main spindle, and ball bearings on the rest of the mechanism where possible. The machine might be built on the unit plan, so that the different parts and attachments could be bought separately. The feed-gears could be easily attached on the side of the main column, which would be the milling machine column as well as the headstock of the combination tool. One feed-screw could be used to handle the lathe feed and threading and also the cross-travel of the milling machine table.

It would be possible to build back-gears into the head or to use the conventional back-gear, the matter of cost, convenience, and dependability deciding this factor. A three- or four-step cone pulley could be used, according to the flexibility needed, or it might be desired to use a three-step cone pulley with a two-step cone for driving, giving a six-speed machine, these details of design to depend on conditions. The main thing is that every small precision and model shop needs a bench lathe and a bench milling machine, and if these were built as a combination machine it would seem that a duplex machine could be built for about one and one-half times the cost of each of the separate machines, thereby saving the buyer 25 per cent of the total investment in two machines.

CHARLES W. WALKER

DON'T DODGE THE WORD "WHY"

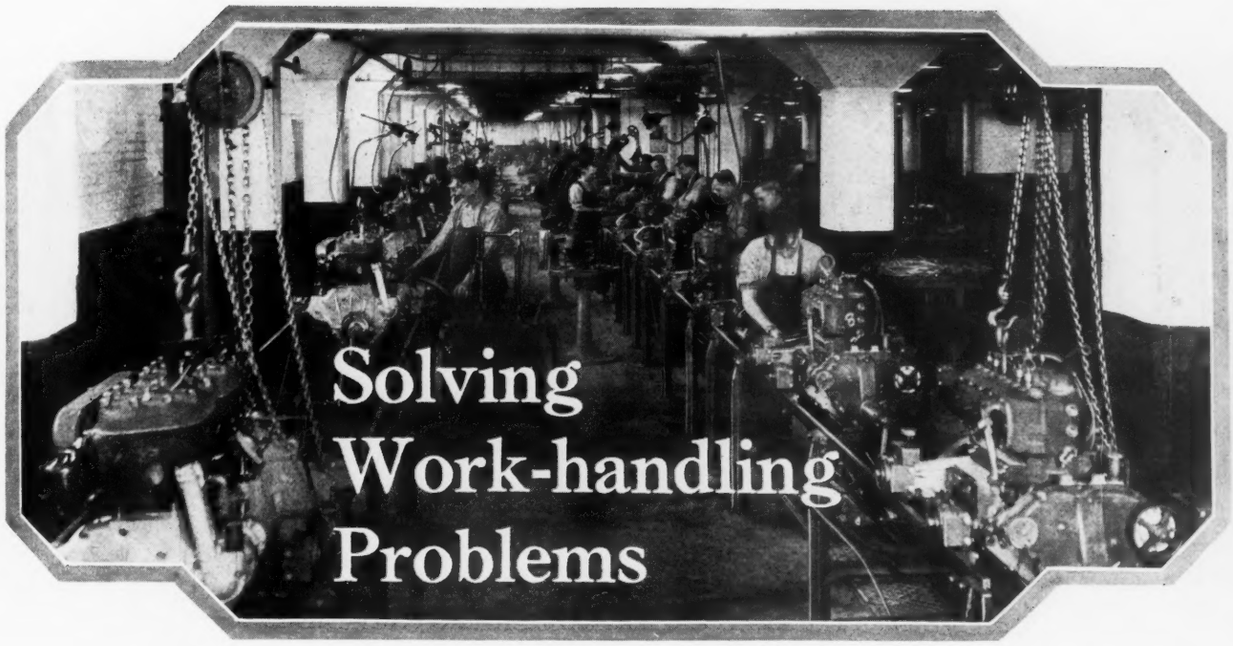
The difference between the usefulness of many men is largely measured by the extent to which they ask themselves "why?" in performing their task. The man who never asks himself the "why" or "wherefore" may be a good routine worker, and he may perform the tasks assigned to him, after they have been properly explained, without giving any occasion for complaint; but he will never be able to handle any important work without being carefully directed, because he has no appreciation of the real purpose of what he is doing.

In engineering work, more than in any other field of activity, it is of the greatest importance that the question "why?" be answered at every step. When a machine does not function as intended, there is a reason. When certain parts break continuously, although they appear to be amply strong enough for the purpose for which they are intended, there is a reason. The man who asks "why?" and who is determined to find out the reason for the difficulty before he tries to remedy it, is the man who is going to succeed in accomplishing whatever he endeavors to do.

Most mistakes made in shop and engineering work are due to a kind of mental laziness; effort is required to answer the "whys" met with in practical work.

It is not possible to find the answer to all the "whys" that arise in engineering work without adequate knowledge; and in addition to having an inquisitive and analytical mind, it is also necessary to have the will to acquire knowledge. It never was so easy as it is today to obtain information on technical and engineering subjects. Books and technical periodicals are within the reach of every man who wishes to obtain information. The future belongs to him who is prepared to answer the question "why?"

S. M.



Solving Work-handling Problems

Equipment Recently Installed by the White Motor Co. to Facilitate the Transfer of Work Between Operations

RAPID-PRODUCTION machines furnished with efficient tools and work-holding fixtures do not constitute the only equipment essential to the successful operation of industrial plants using quantity-production methods. It is also necessary to provide convenient means of transferring parts from machine to machine, from department to department, and along assembly lines to be assembled into machines, automobiles, trucks, etc. In this article, new methods of handling work which have been adopted by the White Motor Co., Cleveland, Ohio, will be compared with the methods previously in use.

Transferring Work from Machine to Machine

Parts were formerly passed by hand to the successive machines employed in finishing them, the parts being deposited on the floor until the succeeding operators were ready to place them in the machines. With large castings, the floor about the machines would frequently become congested, as illustrated in Fig. 1, which shows the group of machines previously employed in finishing the crankcase. Roller and overhead conveyors have now been installed in the crankcase department, as illustrated in Fig. 2, for carrying the castings from machine to machine. In this way, congestion has been eliminated and the labor of the operators has been materially reduced, not to mention the lessened wear and tear on the floor.

In departments engaged in machining smaller parts, the floors often became cluttered, as shown in Fig. 3, under the previous method of transferring work between the machines. Crankshafts were dragged on the floor by operators or a trucker who used hooks. When piled as illustrated, the crankshafts obstructed the aisles and were dangerous to passersby.

Special trucks guided by a floor rail are now employed, as illustrated in Fig. 7, for passing crankshafts and similar parts to the successive machines used in their production.

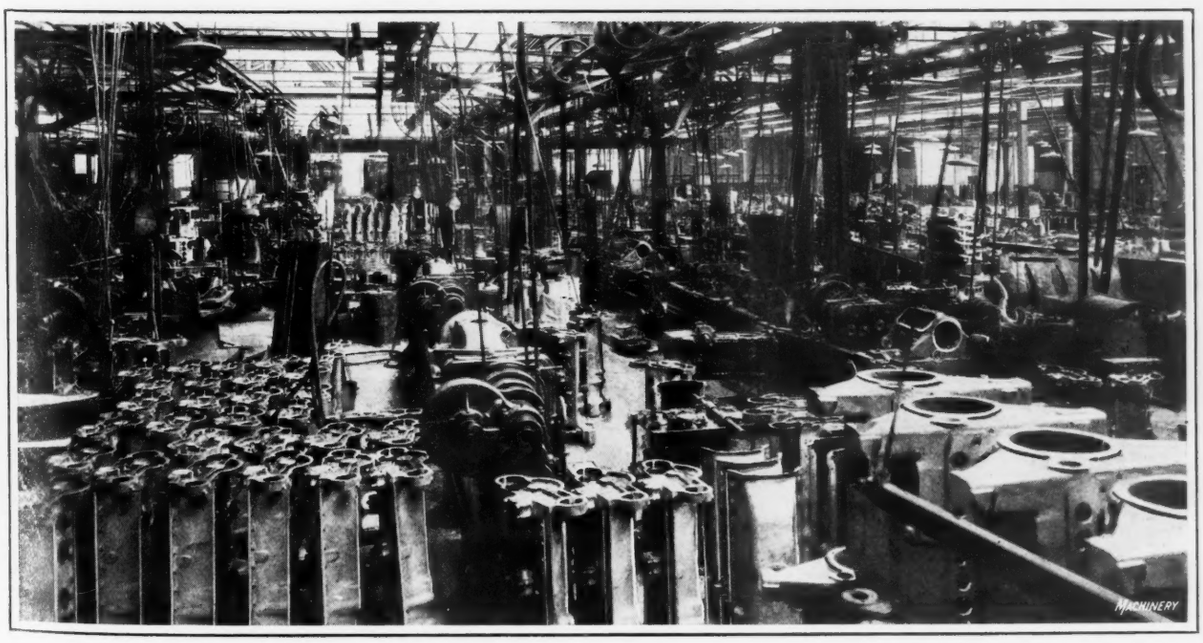


Fig. 1. View showing the Congestion around the Crankcase Group of Machines when the Castings were slid on the Floor from Machine to Machine

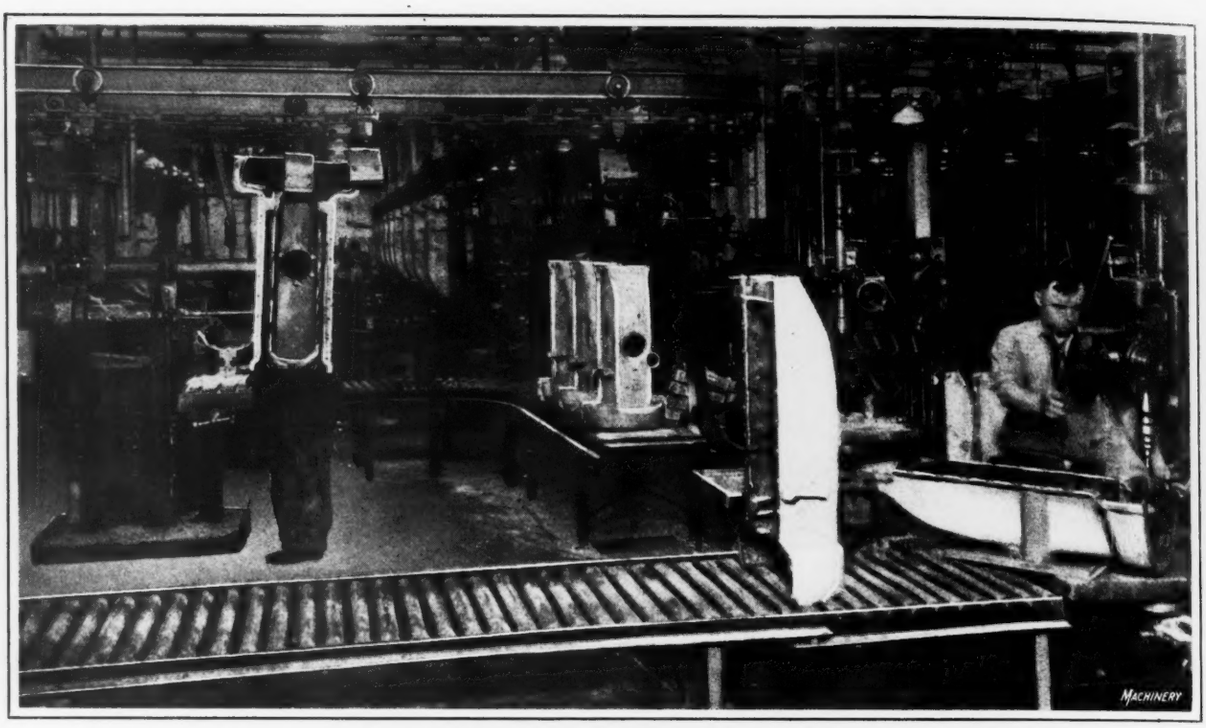


Fig. 2. Overhead and Roller Conveyors now employed to carry Crankcases successively to the Machines used in finishing them

These trucks are equipped with racks for holding the parts in a convenient manner. The racks are of a swivel design, so that the operators have ready access to the crankshafts on both sides. When any given operation has been performed on all the crankshafts on a rack, the truck is simply pushed to the next machine. In the crankshaft group of machines alone, this system of handling the work has eliminated two truckers, who were formerly required to assist the machine operators, and has considerably lessened the labor of the operators. Besides, all crankshafts can be readily observed at any stage of the manufacturing process.

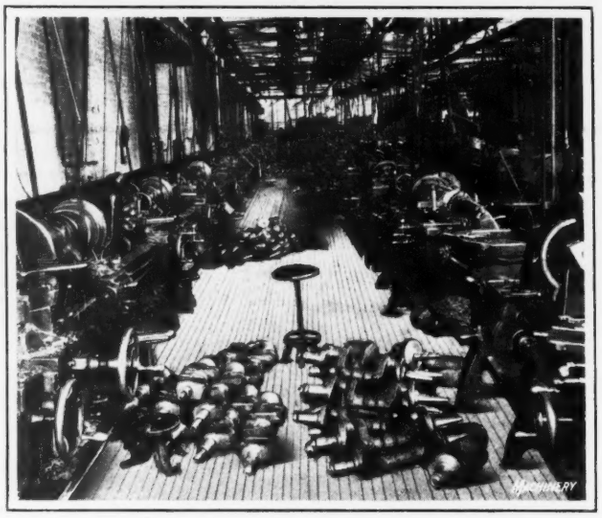


Fig. 3. Another Department in which Parts were simply deposited on the Floor to be picked up by the Operators

It was formerly the custom to place in cans and boxes, as illustrated in Fig. 4, small work that was to be transported from one department to another or to an assembly line. In these receptacles, the parts were often damaged because of jarring against each other, and a great deal of floor space was used up, because the cans and boxes could not be tiered on each other.

Fig. 5 shows a number of special containers or racks which may be conveniently tiered on a skid for transporting about the shop by means of a standard lift truck. Each container is arranged to hold the parts in such a way that they will not

Fig. 4. Cans and Boxes formerly used for transporting Small Sized Parts between Departments

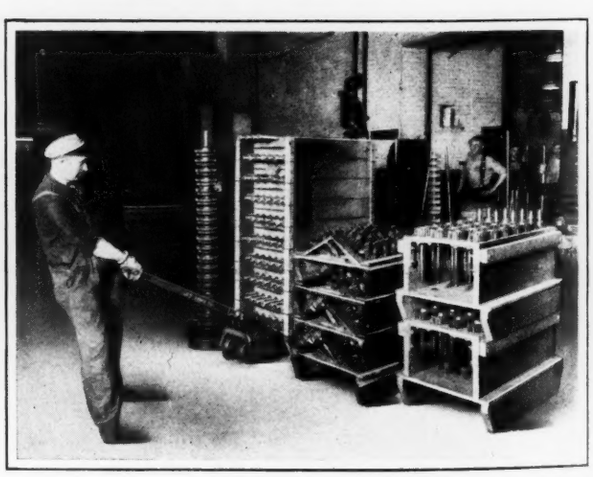


Fig. 5. Special Containers in which Parts are held in a Manner that prevents damaging them

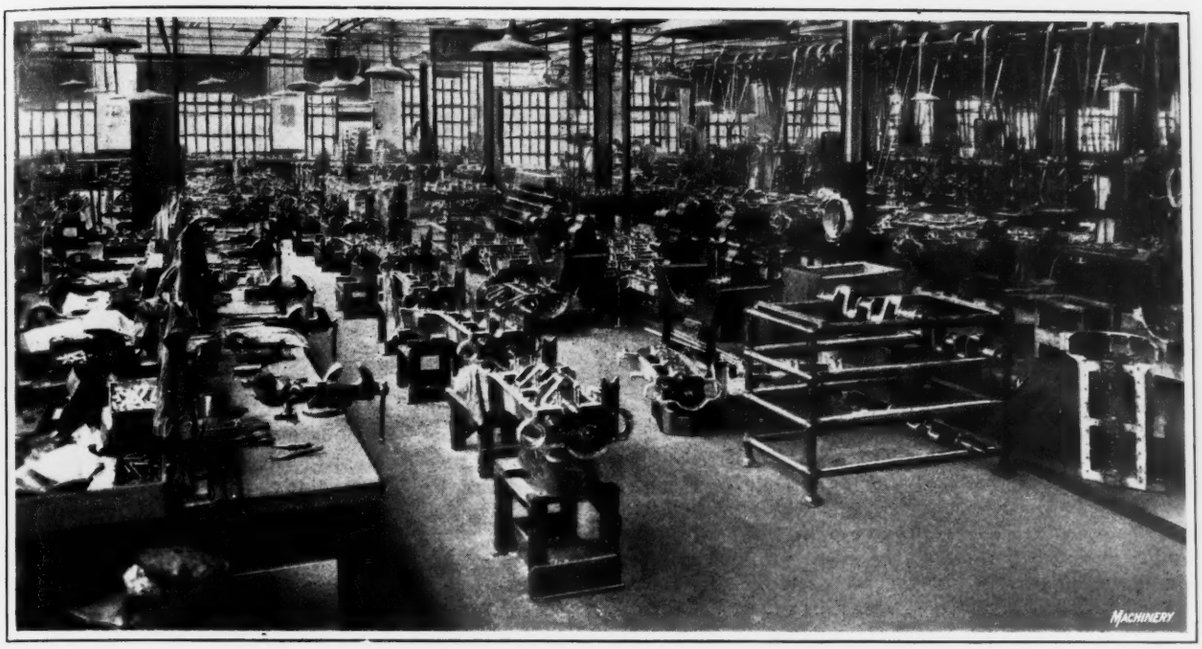


Fig. 6. General View of the Engine Assembly Department when the Motor was practically assembled on Stands

come in contact with each other. Parts can thus be transported without damage, rapid inventory is possible, and an orderly storage arrangement is obtained. It is mentioned that 50 per cent less floor space is required for parts handled in this manner than was formerly the case.

The Engine Assembly Line

An average of one hour and forty minutes is saved in the assembly of each engine due to the installation of the continuous assembly track shown in the heading illustration. Previously, the engine units were placed successively on floor stands, such as illustrated in Fig. 6, until they reached a certain stage in the assembling process. They were then mounted in cradles which were pushed along the floor on rollers to carry them through the final stages of assembly. The method of performing the work was slow and laborious, an average of one engine being completed every fifteen minutes with nineteen men in the assembly line. In the new system, a bracket holding a roller at both ends is bolted across each end of the crankcase. The rollers run on tracks on the assembly line to facilitate passing the units from man to man. A few preliminary parts are assembled to the crankcase on stands near the beginning of the assembly line, this arrangement permitting several men to do the same kind of work. The crankcases can be run directly on the main assembly track from these stands. Sub-assemblies are made at right angles to the assembly line and in the proper sequence for attaching to the unit.

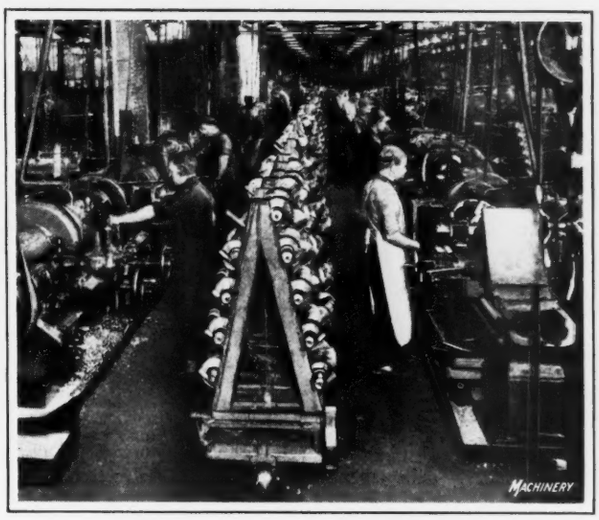


Fig. 7. Special Trucks guided by a Floor Rail which are now used to carry Parts from Machine to Machine

At certain points along the assembly line where it is desirable for a man to stand directly in front or in back of the engine unit for assembling some part, a hinged section of one track rail may be lifted to permit the man to step into the desired position.

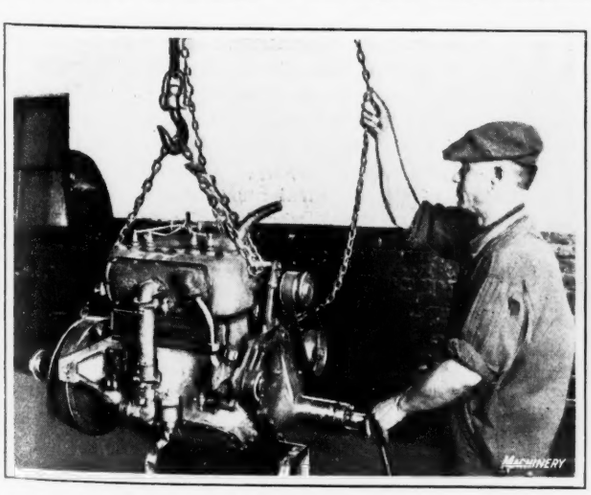


Fig. 8. Former Method of moving the Engine Unit by Means of an Overhead Chain Hoist

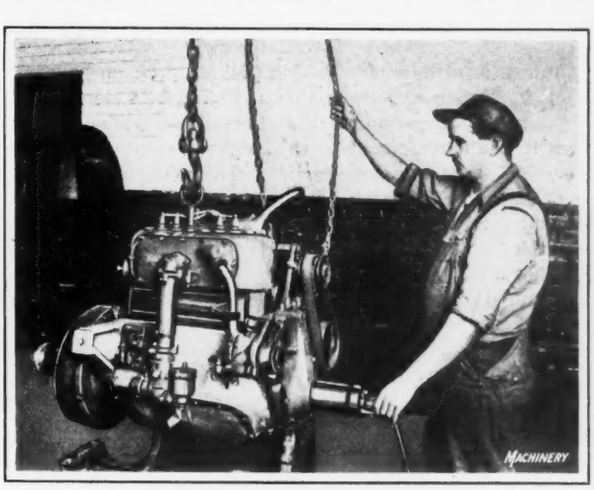


Fig. 9. A Far More Convenient Method of transporting the Engine Assembly by the Use of a Chain Hoist

Also, at several points along the line, the track passes through a tumbler section or cradle which enables the entire engine to be turned upside down. These devices permit the convenient assembly of parts on the sides or on the bottom of the engine. Shelves extend beneath the tracks for stowing containers filled with small parts that are to be assembled. With this new assembly line, thirteen men completely assemble an engine approximately every fourteen minutes.

Convenient Method of Handling Engines Subsequent to Assembly

After the engine has been assembled, it is transferred to several places for testing, cleaning, and assembling into the truck chassis. This transportation is accomplished by means of chain hoists. Formerly it was the practice to loop a chain sling around different parts of the engine unit, as illustrated in Fig. 8, and to connect the hoist hook to this chain. This method was slow and hazardous and required a considerable quantity of chain slings.

Now the practice is to connect the chain hook, as shown in Fig. 9, to an eyebolt screwed into one of the valve plug holes in the cylinder head. Suspension at this point gives a good degree of equilibrium. The eyebolt remains in the cylinder head until the engine is placed in the truck frame after which it is returned to the engine assembly line. Besides being much safer, the new method has eliminated the chain slings and the damaging of parts, and results in the transportation of parts at about twice the former speed.

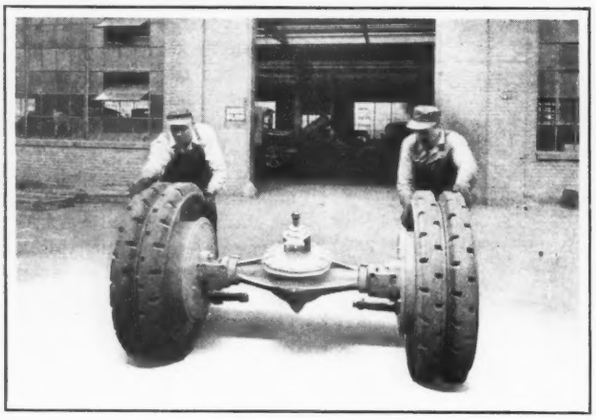


Fig. 10. Rolling the Rear Axle Assembly to the Department in which it is placed in the Chassis

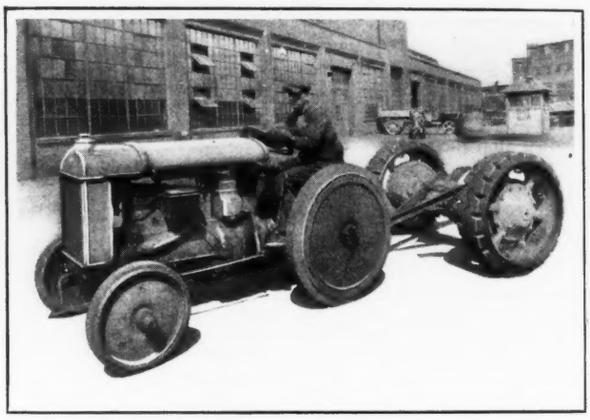


Fig. 11. Present Method of transporting the Rear Axle Assembly between Two Departments

In transporting the rear axle assemblies to the department in which they are placed in the chassis, the previous custom was to have two men roll the assemblies, as shown in Fig. 10. By using the Fordson tractor, illustrated in Fig. 11, one man and a laborious task have been eliminated.

* * *

DUCTILE ARC WELDS

As mentioned in a note in June MACHINERY, on page 790, a step forward in the utilization of the heat of electric arcs for joining metal parts or building metal structures has been taken in the development of two methods of producing ductile welds. One was developed by Dr. Irving Langmuir in the Schenectady Research Laboratory of the General Electric Co., and the other almost simultaneously in the Thompson Research Laboratory of the same company at Lynn, Mass., by Peter Alexander.

In both processes, while the welding is being done, air is excluded from the metal at the joint by means of a bath of hydrogen or other suitable gas. The formation of oxides and nitrides, which are objectionable in the weld metal, is thus prevented; the fused metal is as strong and ductile as the original metal.

The development of the Schenectady method is a good example of the unexpected eventual commercial application of experiments in pure scientific research. Fifteen years ago, while studying the loss of heat of the tungsten filaments of incandescent lamps in an atmosphere of hydrogen, Dr. Langmuir found that at a high temperature, the hydrogen gas was changed from the molecular to the atomic state. Two atoms are grouped together as a unit in a molecule of hydrogen gas; in the atomic state each atom acts as a unit. The molecular form is the more stable, and when the atoms recombine to form the molecules, intense heat is liberated. Dr. Langmuir's study of lamp filaments in hydrogen was a theoretical investigation. Now, fifteen years later, the results have been applied in a different field—in the development of a new and improved method of welding.

Continuing the theoretical investigation, Dr. Langmuir found that more atomic hydrogen was formed by passing a powerful electric arc between tungsten electrodes in hydrogen at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, atomic hydrogen could be blown out of the arc, forming an intensely hot flame of atomic hydrogen burning to molecular form and liberating about half again as much heat as the oxy-hydrogen flame.

By using such a flame of atomic hydrogen, iron can be welded or melted without contamination by carbon, oxygen, or nitrogen. Because of the powerful reducing action of the atomic hydrogen, alloys containing chromium, aluminum, silicon, or manganese, can be welded without fluxes and without oxidation. The rapidity with which such metals as iron can be melted exceeds that in the oxy-acetylene flame, so that the process promises to be particularly valuable for welding. Either alternating or direct current can be used.

Materials of many kinds have been welded with the atomic hydrogen flame. Low-carbon steels up to 1/2 inch in thickness have been welded without additional material, after butting together tightly. Much work has also been done in connection with full automatic welding, using a butt joint, with no metal added to the seam. A number of welds have been made on seamless tubes having a diameter of 4 inches, and with boiler plate 1 inch thick. Welds on deoxidized copper, such as silicon-copper, have been made in metal up to 3/8 inch thick, and given unusually good sections. In testing welds made by this process, the welded portions have been twisted and bent double without being injured.

The process developed in the Lynn Laboratory is based on the utilization of the chemical and physical properties of hydrogen and other gases when in the molecular state. In this process, the arc is struck between the metallic wire or carbon used as one electrode and the plate or work to be welded, used as the other electrode. The crater of the arc is always on the work to be welded. The gaseous atmosphere is supplied in the form of a stream around the arc. Pure hydrogen, water gas, hydrogen-nitrogen mixtures, anhydrous ammonia, methanol vapor, and some other gases can be used, according to the nature of the work. The process makes arc welding more efficient, and suitable for fields which at present are out of its reach. Low-carbon steel, alloy steels, and most of the non-ferrous alloys can be welded with success by this process in suitable gaseous mixtures.

Letters on Practical Subjects

DRILLING EQUALLY SPACED HOLES IN A CIRCLE

The drilling of equally spaced holes in a circle presents some difficulties when only the usual shop equipment is available, especially when a high degree of precision is required and the diameter of the holes is small compared to the depth. When a considerable quantity of such work has to be done, a special machine will soon pay for its cost. A bench lathe equipped with suitable attachments can sometimes be used for small work, however, but it is best in most cases to build a special machine.

In Figs. 1 and 2 are shown the indexing chuck and drill spindle, respectively, used on a bench lathe for drilling the evenly spaced holes in small lantern pinions, a typical example of which is shown at *H*, Fig. 1. The holes drilled in blanks of this kind range from 0.007 to about 0.040 inch in diameter and are spaced on circles of any desired diameter up to 1/2 inch. The number of evenly spaced holes may be six or more and the spacing must be very accurate. The drilled blanks for the lantern pinions are fitted with steel rounds which must be a light press fit in the drilled holes. The diameter of the pitch circle on which the evenly spaced holes are drilled must also be very accurate. In order to insure accuracy in locating and aligning the blank, it is provided with a centering boss *J* and holding flange *K*, as shown at *G*. After the holes are drilled, the flange and the boss are turned off.

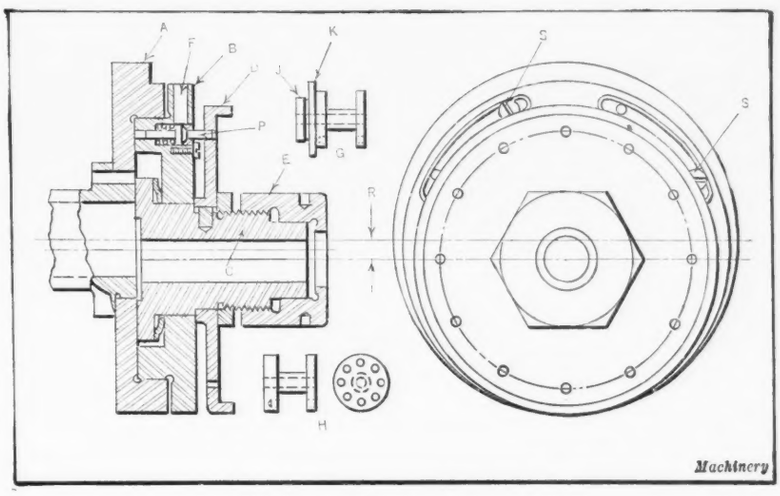


Fig. 1. Indexing Chuck used on Bench Lathe

An accurate centering tool is used, and the drills employed are preferably of the flat type, ground true and carefully sharpened after grinding. In order to insure drilling straight holes, the spindle on which the indexing chuck shown in Fig. 1 is mounted, is run at a speed of 1500 revolutions per minute. The drill spindle shown in Fig. 2 is run in the opposite direction. With this arrangement, the tendency for the drill to run off the axis of rotation, due to an inaccurately shaped or crooked drill or a lack of uniformity in the material, will be minimized if not entirely eliminated.

To adjust the member *B*, Fig. 1, so that the dimension *R* will equal the radius of the circle on which the holes are to be drilled, the machine screws *S* are loosened, and member *B* rotated in the holder *A* until the center of the offset work-holder *C* is in the required position, after which the screws *S* are tightened. Member *B* is bored and ground to fit work-holder *C*. The boss *J* on the work fits the hole in part *C*, and serves to locate the work, which is clamped in place by screwing the cap *E* down on the flange *K*. The spacing of the holes is obtained by the index-plate *D* and the indexing pin *P*.

The body *A* of the chuck is either made a part of or is rigidly and permanently attached to the headstock spindle or to a spindle directly connected to the shaft of a constant-speed motor. In either case, the spindle should be exceptionally large and equipped with the best bearings obtainable. It will be noted that the work-holder is eccentrically located with reference to the axis of the spindle, the body *A*

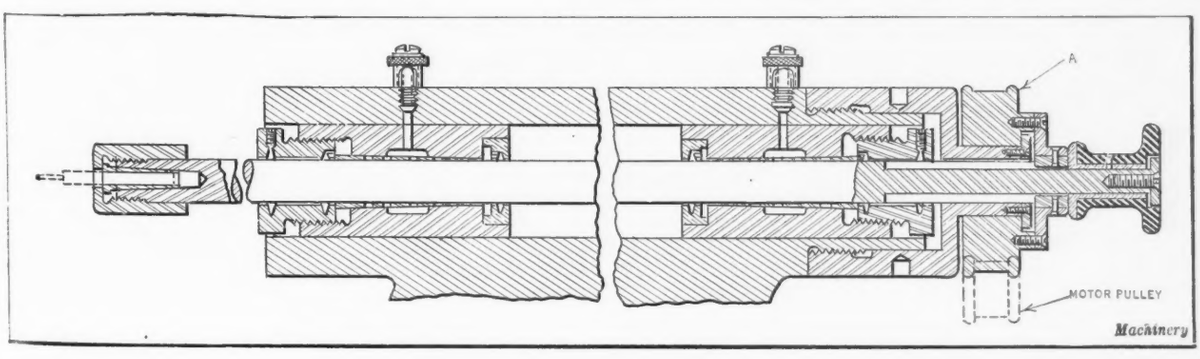


Fig. 2. Drilling Spindle used on Bench Lathe

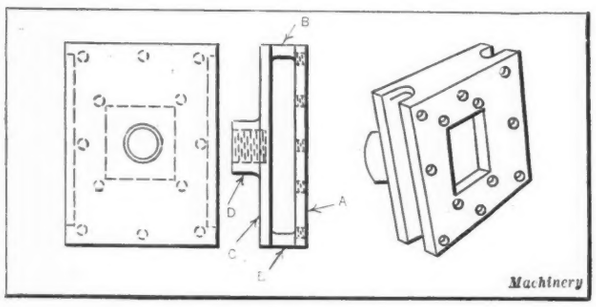
being bored and ground eccentrically with respect to the axis of rotation to receive the adjusting member *B*.

The drilling spindle shown in Fig. 2 is driven by means of a pulley *A* having a bearing on the spindle housing, the connection between the pulley and the spindle being made by a spline so that the spindle will not be subjected to the pull of the belt. By means of a series of interchangeable pulleys, suitable drilling speeds can be obtained. The driving motor employed with this spindle was equipped with ball bearings and had a speed of 10,000 revolutions per minute. This motor was mounted on a bracket attached to the rear of the lathe tailstock. The drill is fed in by hand, the spindle being mounted in long adjustable dustproof bearings. In order to simplify the construction and insure greater accuracy, the shanks of all drills and centering tools are made the same size to fit one holder.

Berwyn, Ill. L. E. KING

LATHE FACEPLATE FOR ODD-SHAPED PARTS

The regular type of circular faceplate cannot be readily employed for holding odd-shaped work without using blocks, special clamps, or spacing attachments. A form of faceplate that was devised in one shop for holding a variety of castings having lugs, bosses, etc., is shown in the accompanying



Faceplate for holding Odd-shaped Parts

illustration. The faceplate was made up of a rectangular-shaped casting, the face *A* being supported by two legs *B*, extending from the body *C*, which was provided with a hub *D* threaded to fit the end of the lathe spindle. A large square opening was cut in the center of plate *A* to provide for tool clearance and also to permit the use of clamps for securing the work in place.

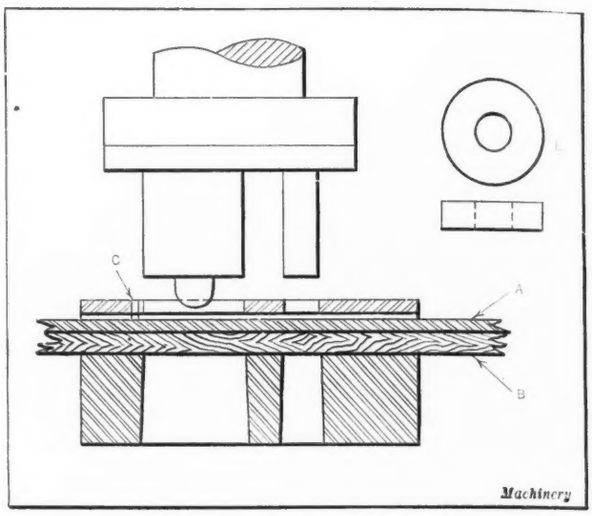
As will be evident from the illustration, the extended face permits parallels and C-clamps to be readily employed, while the numerous tapped holes in the plate *A* permit the usual U-shaped clamps to be used when necessary.

Washington, D. C. G. A. LUERS

CUTTING FELT WASHERS ON A PUNCH PRESS

While employed in a large automobile plant, the writer was confronted with the problem of cutting out a lot of felt washers, 1/4 inch thick, like the one shown at *E*. Cutting these washers out with a pair of shears was, of course, a tedious job. There was a die in the shop like the one shown in the illustration, which had been used to cut metal washers of the same size as the felt washers, and the writer attempted to use this die for cutting out the felt washers. However, it was impossible to obtain washers with clean cut edges by employing the die in the usual manner.

After various methods had been tried, a toolmaker of considerable experience suggested that we place 1/16-inch thick sheet metal *A* on top of the felt *B*, and stamp the steel and the felt together. This method worked out so well that it is now employed whenever felt washers are required. In order to use this equipment, however, it was necessary to remove the stop-pin from the die and place it in the stripper



Die used for cutting Felt Washers

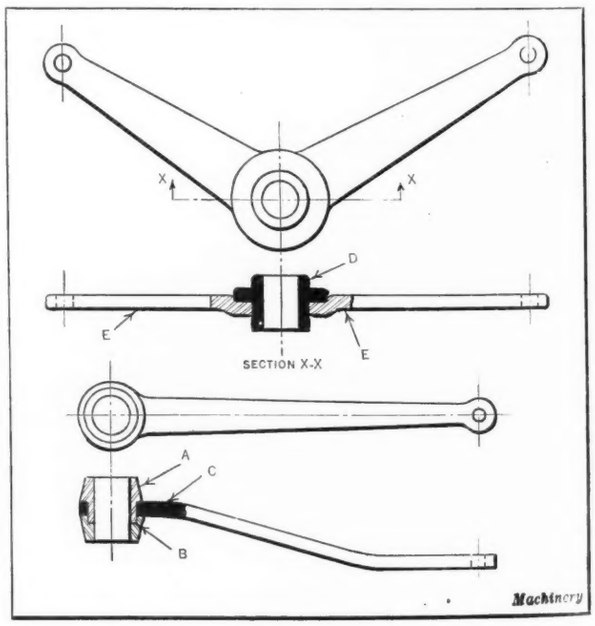
plate, as shown at *C*. As the steel washers are used regularly in the assembly department, no waste of material results from this practice.

Philadelphia, Pa. CHARLES KUGLER

MAKING SMALL LEVERS FROM STAMPINGS

Levers for transmitting motion from the accelerator pedal to the carburetor of a certain make of automobile were formerly made from forgings. The forgings were hot- and cold-pressed in the forge shop, and the bosses then drilled and reamed. Following the drilling and reaming operations, the forgings were polished and enameled black. The management decided that if these levers were nickel-plated their appearance would be greatly improved. It was found, however, that nickel-plating the forgings was a very expensive operation, and the amount of polishing required to secure a suitable surface for plating made it practically impossible to handle the work on a satisfactory production basis. This difficulty was overcome and the cost reduced by making the levers from stampings assembled to hubs produced on the screw machine.

Two styles of levers were developed, one for use where clearance was limited on the large boss end, and the other for use where there was a large clearance. The construction



Small Levers made from Stampings and Screw Machine Parts

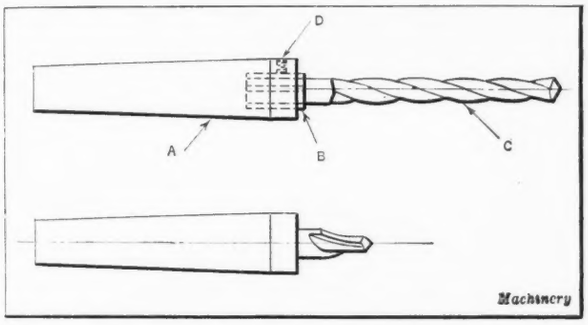
of the two types is clearly shown in the accompanying illustration. The three-piece type, shown in the lower view, is butt-welded, so that the three pieces *A*, *B*, and *C* become one solid unit. The two-piece type, shown in the upper view, is spot-welded at four places so that the hub *D* is securely attached to the arms *E*.

Detroit, Mich. F. EDGAR

TOOL-HOLDERS MADE FROM OLD LATHE CENTERS

Old or worn-out lathe centers can be employed to advantage as holders for drills, countersinks, or other small tools, which are generally held in a small chuck in the tailstock spindle. In the upper view of the illustration, is shown an old lathe center which was squared up at the end and drilled to receive a drill bushing *B* in which the drill *C* is clamped. The bushing *B* is split and is made to grip the drill by tightening the set-screw *D*. In the lower view is shown an old lathe center which was provided with a center drill.

The writer believes that it would be a good plan to make up tool-holders like the one shown in the lower view, and equip them with center drills. A lot of tools made up in this way could be kept on hand in the tool-room. Then, instead of obtaining a center drill, a chuck for holding the drill, and



Worn-out Lathe Centers used as Tool-holders

a wrench for operating the chuck, from the tool-room, the workman would receive a complete centering drill and holder, and give the tool-crib tender one check, whereas three checks would be required for the usual centering equipment.

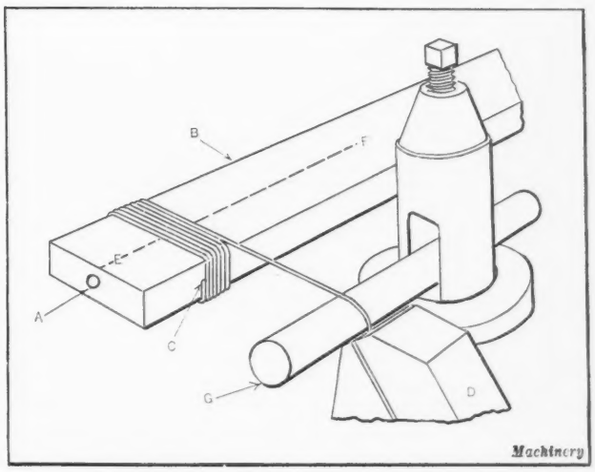
Bloomfield, N. J. GEORGE W. JAGER

MAKING STAPLES ON THE LATHE

A rush order for soft wire staples recently given to the foreman in a certain shop was handled in an interesting manner. The staples were to be made from 1/16-inch iron wire with a gap of 5/8 inch and a length of 1 inch. The usual bending methods were discarded, as they required too much handling and consequent loss of time. At last the method to be described was hit upon, which consisted of winding the wire on an arbor, as shown in the illustration, and then cutting the wire at the middle point on each side of the arbor.

A piece of cold-rolled steel *B*, 5/8 inch by 2 inches by 12 inches long, was centered at both ends, as indicated at *A*. A 1/16-inch hole was drilled at *C* and the bar then mounted on centers in the lathe with a driving dog attached. The end of the wire was inserted in the hole *C* and stretched back over a piece of 3/4-inch round stock *G* clamped in the toolpost. The wire was held on the back side of the round bar by the wood clamp *D*, which served as a friction tension. With this equipment, the wire was wound on the arbor *B* the same as in winding a coil spring.

After winding the arbor full, it was removed and the wire tapped lightly with a hammer in order to form sharper bends at the corners. A line was drawn down the center of the wide side of the winding on both sides of the arbor, and the windings cut on this line with a cold chisel. The staples



Method of winding Wire that is to be cut to form Staples

thus formed on each edge of the bar were sufficiently accurate to meet requirements.

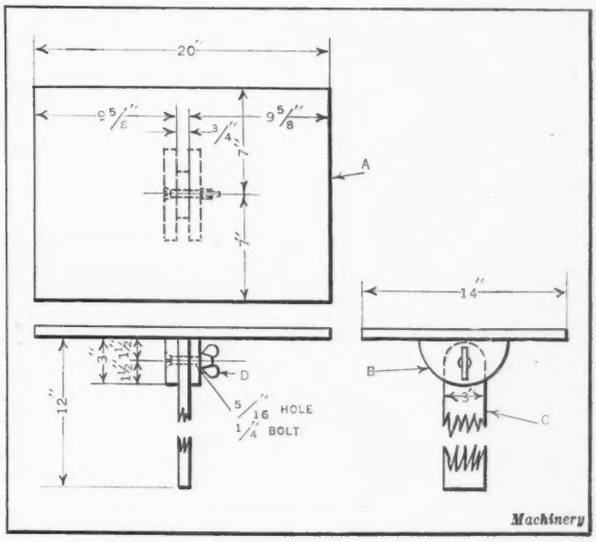
Walpole, Mass. JAMES A. KIRK

ADJUSTABLE SHOP DRAWING-BOARD

A machinist or patternmaker often finds it necessary to make a sketch or drawing of some article that is to be constructed in the shop. A practical drawing-board for use in such cases is shown in the illustration. A smooth board of any size desired may be used, but one about 14 by 20 inches generally meets all requirements. After obtaining the board *A*, two semicircular pieces of wood *B*, having a radius of about 3 inches, are cut out. A 5/16-inch hole is then drilled in the center of each semicircular piece, as indicated. The two semicircular pieces are nailed to the center of the drawing-board, leaving a space 3/4 inch wide between their adjacent faces. Care must be taken to have the 5/16-inch holes in line.

A piece of wood *C*, 3 inches wide by 12 inches long by 3/4 inch thick, is rounded over at one end, and a 1/4-inch hole drilled about 1 1/4 inches from the end. This piece of wood is placed between the semicircular blocks, and a small bolt slipped through the three holes to form a swivel joint. By using a wing-nut *D*, the board can be quickly clamped in place at any angle to which it may be tilted or adjusted. The board *C* may be clamped in the vise or secured to a post in any convenient location. The ends of the drawing-board should, of course, be carefully trued up, so that a draftsman's T-square can be used in the customary manner.

Saginaw, Mich. ERWIN LEHNHARDT



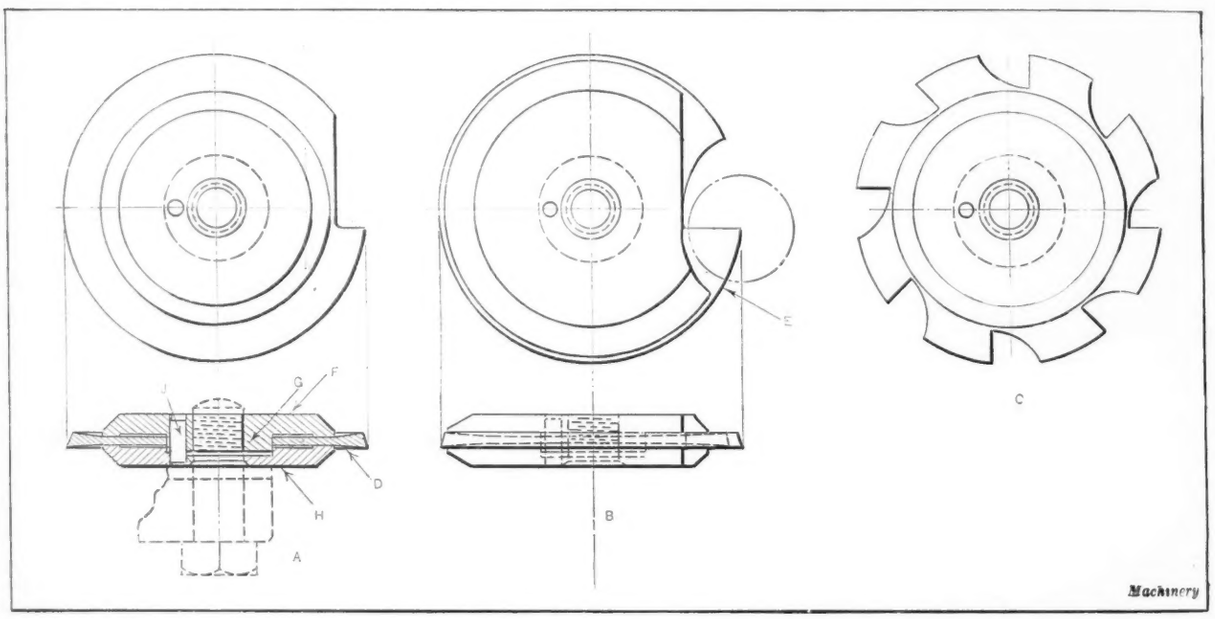
Adjustable Drawing-board for Shop or Drafting-room

HOLDERS FOR THIN CIRCULAR CUT-OFF TOOLS

The great number of cut-off tools of different form and thickness required in job work on screw machines, and the short life of many of these tools as the result of overheating and breakage, led the writer to devise the cut-off tool-holder illustrated. The resulting economy would have justified the making of these holders even if their cost had been ten times as great.

The holder is applicable in all cases where the cut-off tool is not required to "break down" or form the end of the bar. By making the tools from thin disks, the material expense is reduced to about one-third, with a similar reduction in machining time. The danger of cracking in hardening is also greatly reduced, owing to the uniform thickness of the cutter. Worn out slotting saws, and milling cutters ordinarily useless, are given a new lease on life as cutting-off tools for the softer materials by making use of holders like the ones shown.

The holder shown at *A* is materially smaller in diameter than the circular tool *D*, while the diameter of the one shown at *B* is nearly as large as the cutter *E* and is intended for work of large diameter or work that requires a relatively thin tool. Holder *A* is intended for ordinary, medium-sized work, and has a slight advantage over the holder shown at *B* in that it need not be adjusted with respect to the tool, inasmuch as it has no notch. In other respects, both holders are identical.



Holders for Circular Cutting-off Tools

Each consists of a main part *F*, formed on its inner face with a hub *G*. Hub *G* is threaded to fit the regular form-tool clamp-screw which passes through cover *H*. Cover *H* is recessed to fit hub *G* and bears against the toolpost. Both parts are cut down slightly on their inner faces, leaving only the portion near the periphery to bear on the circular tool. The pin *J*, which is tightly driven into the main part, insures that the two parts will be assembled correctly. It is advantageous to make the hub *G* of a size corresponding to the hole in the slotting saws or milling cutters ordinarily used in the shop, as they make excellent cutters for some kinds of work.

Regular cutters can be made either from flat stock or from the bar, and can be formed with any clearance desired. The operator can grind a number of teeth ready for use, as at *C*, thus enabling him to reduce the time required for regrinding and resetting the cut-off, to one-tenth the usual time. Non-shrinking tool steel, drawn to a blue color, should be used in making the holders.

Santa Ana, Cal. HENRY SIMON

USING FORD PARTS IN BUILDING MACHINERY

The Ford car has probably been used for more extraordinary purposes than any other mechanism in the world. In a large industrial plant that builds its own special and automatic machinery, some interesting applications of Ford parts have been made in the construction of special equipment. In one instance, a machine was required, the most important part of which was a powerful drive. Instead of bothering with the design and manufacture of this drive, a requisition was put through for the rear drive worm-wheel, worm, shafts, and roller bearings of a Ford one-ton truck. As the shop was located near a Ford service station, these parts were obtained without delay. The required machine was then literally built around the standard automobile parts as a nucleus, with a considerable saving of time and money.

In another case, the clutch of a machine already built gave considerable trouble. After endeavoring to remedy the trouble without success, the clutch was removed from the machine, and an ordinary Ford model T clutch purchased and installed in its place. Fortunately, the design of the machine was such that the substitution could be easily accomplished. The results were entirely satisfactory, and no more trouble was experienced with this particular machine.

The installations referred to are but two of the many instances where standard Ford parts were used in this particular plant in the construction of automatic machinery. This practice impressed the writer as being a good one, and it would seem that Ford catalogues of parts should prove a valuable addition to the technical library of any designer of automatic or special machinery.

New York City B. J. STERN

FENCE TYPE GUARDS FOR PRESSES

The fence type of guard has been found very satisfactory for a number of press operations, such as the shearing, bending, forming, and piercing of flat blanks, and other shapes that will go under the guard easily. This is especially true of work done on an inclined press, where the work slides into and drops off the die by gravity. When we consider the methods by which the guarding of the die is accomplished, we find that the situation is by no means satisfactory. The guards are usually improvised from any material that happens to be on hand, and are likely to be incomplete and flimsy. They often obscure the work, in which case it is difficult to prevent the operator from removing the guard.

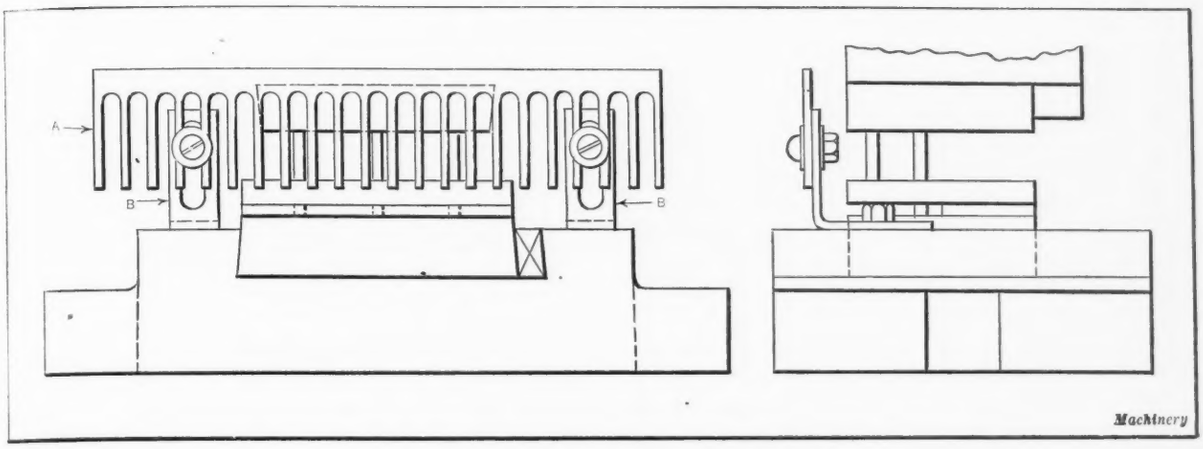


Fig. 1. Fence Type Guard mounted on Punch Press

When guards of this kind are used, the foreman sometimes leaves them off in setting up the tools for a short run, as he thinks that it is not worth while to hunt up the necessary material, especially as he will probably be through with the job before the superintendent or the safety inspector comes around. The guard shown in Fig. 1 was developed to meet this situation. It is inexpensive, being made from easily obtainable material, and is heavy enough to be rigid. It can be adapted to various requirements.

The device consists of two elements, the guard *A* and the brackets *B*, with the necessary screws for mounting and assembling. The guard is made from cold-rolled steel, slotted as shown in Fig. 2. While the slots are shown with round ends, they could be made any convenient shape. If the number of pieces required is large, it is cheaper to make up a simple set of slotting tools and slot the guards in a press. If the number required is small, the blanks may be clamped together, and the slots produced by milling.

If a large number of angles *B*, Fig. 1, are required, a simple set of press tools may be made up for piercing the slots. Otherwise, they can easily be worked out with a drill and file. The brackets are secured to the tools by catching them under the heads of the screws that hold the stripper or gages. The size of the slots in the guard and brackets is such that the screws can be inserted in practically any position. The guards can be cut off to any desired length with a hacksaw. They can also be bent to any shape desired. By the aid of a drill and a few additional strips of steel, excellent guards of a more complicated type can be built up.

Riverside, Ill. F. MARTINDELL

DETERMINING TEMPERATURE WITH SOLDER

The writer read with interest the article entitled "Determining Tempering Temperature with Solder," in May MACHINERY, page 734. There is one important point that must not be overlooked in using solder to determine the temperature—namely, the fact that all solders do not have the same melting temperature.

The writer once tempered a die with solder that was assumed to have a melting point of 425 degrees F., the same as the solder that had previously been employed. When placed in operation, the die chipped on the cutting edges to such an extent that it was obvious that the tempering temperature, as determined by the solder, was incorrect. In this case, the actual melting point of the new solder, found by placing the solder in oil and heating the oil until the solder melted, was 350 degrees F. A table of melting points of lead-tin alloys of various compositions will be found in the sixth revised edition of MACHINERY'S HANDBOOK on page 1380. The variations in melting temperatures, as given in this table, indicate how necessary it is to know the melting point of a solder before using it to determine tempering temperatures.

Philadelphia, Pa. CHARLES KUGLER

DIE FOR TRIMMING U-SHAPED STOCK

In the accompanying illustration, is shown a die in which some unusual features are incorporated, the principal one being the use of a pair of rolls for cutting off the work. These rolls function in much the same manner as those used in pipe-cutters. The work trimmed is shown at *W* in the upper left-hand corner of the illustration, and by heavy dot-and-dash lines in the die. The rolls cut off the sides of the work at *X* while a circular-shaped punch cuts off the upper portion at *Z*. The base *A* of the die holds an inverted U-shaped form *B* over which the work fits. At the end of this form is a hardened shearing blade *C* of the same shape as the form. The outer face of the shearing blade can be

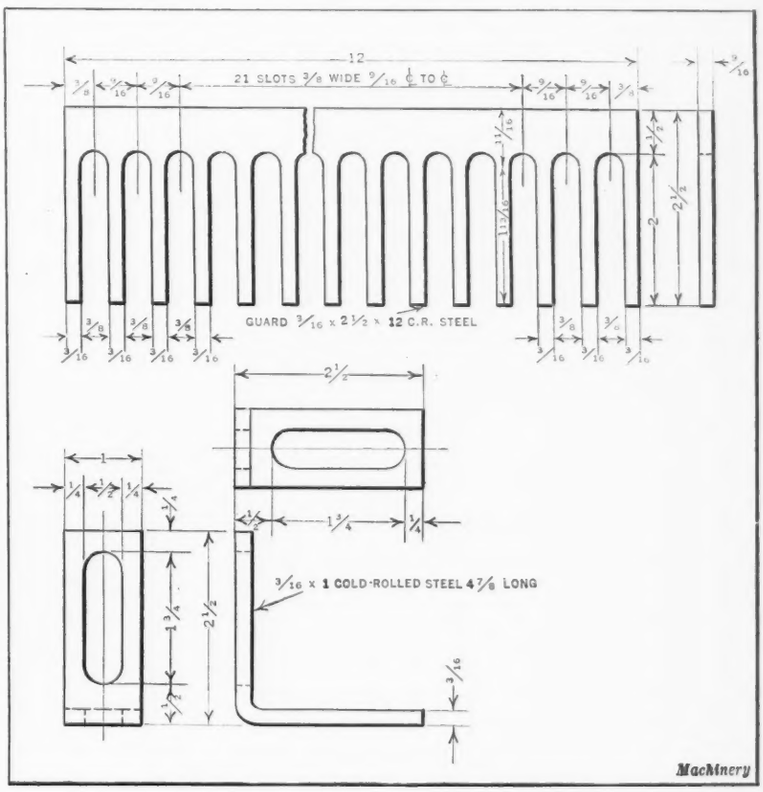
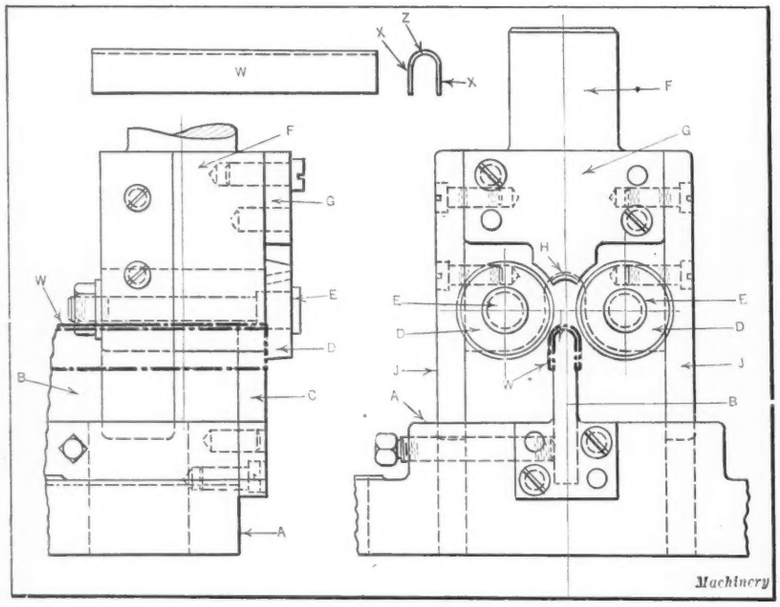


Fig. 2. Details of Guard Material and Angle Brackets



Trimming Die for U-shaped Stock

ground to give a sharp cutting edge. Only a slight clearance space is allowed between the rolls *D* and the cutting face of blade *C*.

Rolls *D* are mounted on studs *E*, and are free to revolve; studs *E* being attached to the holder *F*, which, in turn, is secured to the ram of the punch press. A hardened punch *G* is mounted on holder *F*. The formed cutting end *H* of punch *G* trims the round portion of the work at *Z*. A pair of guide bars *J* entering slots in holder *A* serve to keep the upper and lower members of the die in alignment. The slots in which the guide bars *J* slide have a clearance at the ends to permit endwise adjustment of the base *A*. This construction allows the rolls to be positioned properly, so that the required shearing action may be obtained.

In using the die, the operator simply places a piece of work in the position shown by the heavy dot-and-dash lines, and trips the press. As the punch-holder descends, the rolls, coming in contact with the work, revolve and trim or cut the sides *X*; at the end of the stroke, the punch *H* completes the cutting-off operation. The slight burr left on the inner edge of the work can be easily removed with a file if necessary. This die is used primarily for cutting off formed stock to the lengths required for manufacturing purposes. An adjustable gage, or stop, in the form of a rod attached to the bolster plate of the press is used to locate the end of the stock so that as many parts of the same length as are required can be cut off.

F. SERVER

The screwdriver shown in the illustration was originally intended for use in tightening screws on a punch press die, where the distance from the die to the punch was limited and only a very short stroke could be taken with the ordinary type of gooseneck screwdriver. These particular dies gave considerable trouble unless frequently cleaned, and in order to clean the dies properly without removing and resetting them, it was necessary to take the stripper out, which, in turn, necessitated the removal of several screws. After having tried various kinds of appliances, the worm and worm-wheel operated screwdriver shown in the illustration was made. This screwdriver proved easy to operate, and enabled the workman to tighten the screws securely.

Referring to the illustration, *D* is a small brass worm-wheel, 3/4 inch in diameter, with thirty-two teeth. The screwdriver blade *C* is tightly pressed into the hole in the worm-wheel, and is prevented from turning by the small V-shaped lugs which fit into notches in the hub of the worm-wheel. After being assembled in part *A*, the shank of the blade is riveted over at the top. The worm-wheel is operated by the small steel worm *W*, which is securely fastened to the spindle *H*. A handle *K* is driven on the squared end of spindle *H*, as shown. The parts *A* and *B* are made from 3/32-inch sheet steel, the hinge-shaped portion being formed to the required shape and the hole finished with a 3/16-inch reamer.

It will be noted from the illustration that, when assembled, the hub of wheel *D* fits in the 7/16-inch hole in part *B*, and the upper end of blade *C* fits the 1/4-inch hole in part *A*. The filler collar *F* serves to space the two members *A* and *B* the proper distance apart, and the screw *G* and nut *E* hold the assembled parts securely in place. This tool has proved very satisfactory for the work for which it was originally designed, and is continually in demand for use on other assembly jobs.

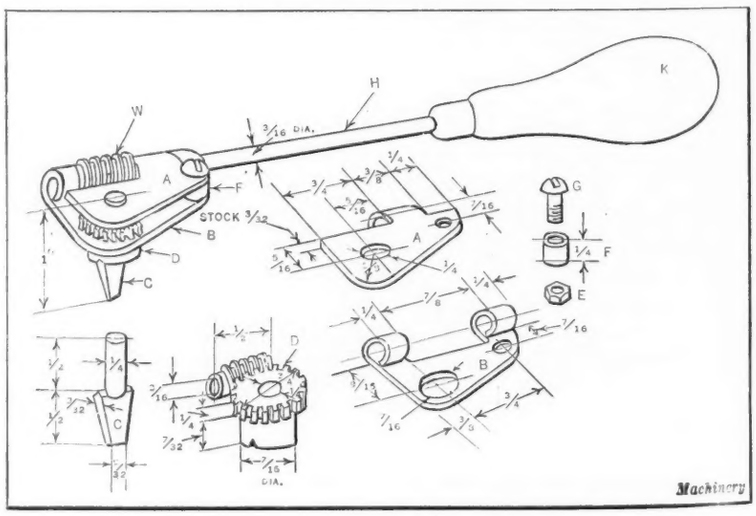
Devon, Conn. WALTER E. FLADD

* * *

On July 1 the United States Government owned 1005 merchant ships representing a tonnage of over 5,100,000 gross tons; 206 ships of 769,600 gross tons were disposed of during the fiscal year ending June 30, 1926. Less than 35 per cent of the present fleet owned by the government is now in active service. There are 1206 ships of over 1000 gross tons privately owned in the American merchant marine, representing a gross tonnage of 5,760,000.

SCREWDRIVER FOR USE IN INACCESSIBLE PLACES

In the accompanying illustration is shown a screwdriver constructed for use where a gooseneck screwdriver is often employed. The ordinary gooseneck screwdriver is frequently unsatisfactory, because it slips off so easily, and in many cases does not permit the screw to be tightened sufficiently. With the screwdriver shown, screws can be set down and released in places where there is but 1 1/4 inches head room, and by shortening the blade it can be employed where there is only 3/4 or 5/8 inch head room. The purpose of the screwdriver is to tighten or set the screw in place after it has been started and turned down as far as possible with the fingers, or to release the screw sufficiently to permit it to be easily removed.

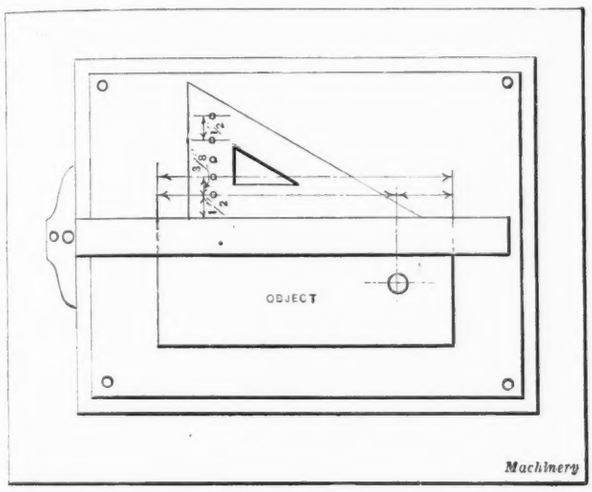


Screwdriver for Use where Head Room is Limited

Shop and Drafting-room Kinks

UNIFORM SPACING FOR DIMENSION LINES

Often the appearance of a drawing is spoiled by unevenly spaced dimension lines. A suitable guide for making the spacing of the lines uniform may be incorporated in the 30-



Triangle with Guide Holes for spacing Dimension Lines

60-degree triangle. The guides are simply holes drilled through the triangle. Generally a space of 3/8 inch between the parallel dimension lines will be found about right. The first hole in the triangle may be drilled 1/2 inch from the base, as indicated in the illustration, and the last two holes may be 1/2 inch apart, so that the first dimension line may be drawn 1/2 inch either above or below the edge of the drawn object.

In drawing the dimension lines, the point of the pencil is placed through one of the holes, and the triangle slid along the edge of the T-square. By repeating the sliding operation with the pencil point in successive holes in the triangle, a series of uniformly spaced dimension lines may be drawn. In drawing vertical lines, the triangle with the evenly spaced holes is guided by the edge of the 45-degree triangle.

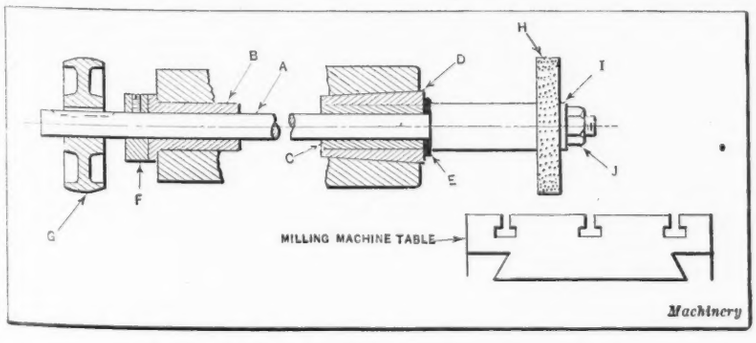
Saginaw, Mich. ERWIN R. LEHNHARDT

GRINDING ATTACHMENT FOR MILLING MACHINE

In the accompanying illustration is shown a milling machine attachment employed in a small tool and repair shop for surface grinding operations. It was constructed at small cost, and has proved satisfactory for grinding long shear blades, straightedges, large dies, punches, etc. The attachment consists of the spindle or shaft *A*, the brass bearing bushings *B* and *C*, the tapered holder *D* for holding bushing *C*, the fiber washer *E*, the thrust collar *F*, driving pulley *G*, grinding wheel *H*, washer *I*, and nut *J*.

The tapered bushing holder *D* fits the taper in the end of the milling machine spindle. The milling machine spindle remains stationary and the grinding spindle *A* revolves in the stationary bearing bushings *B* and *C*. Pulley *G* is keyed to the shaft, and is driven from either a lineshaft or the milling machine countershaft. The fiber washer *E* takes the end thrust on the spindle, and the collar *F* is adjusted to take up the end play. The micrometer dials on the milling machine table feed-screws are of great assistance in obtaining accuracy.

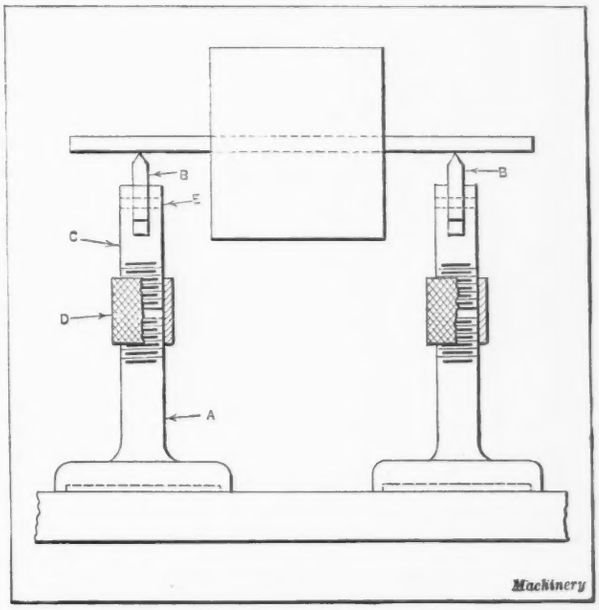
Columbus, Ind. JOE R. COWLES



Grinding Spindle and Bearings for Use on Milling Machine

BALANCING WAYS

The balancing ways shown in the accompanying illustration were intended primarily for use in balancing grinder drums, but have been found very convenient for general



Knife-edge Ways for Static Balancing

static balancing requirements. The straightedges *B* are of the knife-edge type, and each is supported by two stands consisting of a base *A*, adjusting nut *D*, end *C*, and cross-pin *E*. Nuts *D* are used for adjusting the straightedges to the proper balancing positions. The pins *E* which hold the ends of the straightedges in place allow a sufficient swinging or pivoting movement to prevent any distortion or bending of the blades. Balancing stands similar to those shown in the illustration could readily be made up from pipe fittings at a small cost.

Philadelphia, Pa. CHARLES KUGLER

* * *

During the first six months of this year, the United States shipped to Russia more than 10,000 tractors, valued at $5,000,000—or five times as many as in the same period of 1925.

Questions and Answers

EMPLOYERS' LIABILITY

L. T. P.—Under what circumstances and to what extent does the law expect an employer to keep his factory in a safe condition to prevent injury to the workmen?

ANSWERED BY LEO T. PARKER, ATTORNEY AT LAW

A.—For compliance with the law, as well as good policy, it is the duty of each employer to furnish a safe place for his employes to work. Moreover, if for any reason, the place is unsafe, the employer may be liable for the injuries sustained by his employes. However, an employer is not liable for the injuries sustained by an employe in a factory that is ordinarily safe but that is made unsafe solely by the negligence of the workman himself or his fellow-workers.

The law merely requires that the place of work be made as reasonably safe as the circumstances will permit, so that persons who are engaged in various labors may not be subjected to unnecessary dangers. In other words, an employer is not required to supply absolutely safe appliances with which to work, as it is sufficient if he exercises ordinary care to furnish tools, machinery, and other apparatus that are reasonably safe.

For example, where an employe sought to recover damages for an injury received as a result of defective mechanism, the Court held that the mere fact that a machine is defective is not sufficient to render an employer liable, because the employe must show that the defective condition of the appliance was the proximate cause of the injury.

Ordinarily, the circumstances that surround the happening of an accident tend to determine whether or not the employer is at fault. For this reason, it is obviously good policy for an employer or a factory owner to thoroughly inspect, or have inspected, the various machines at frequent intervals, so that in case it is necessary, he may submit convincing evidence to a Court that he exercised caution and carefulness to maintain all the equipment in a reasonably safe condition.

WHY DOES HARDENED STEEL SOMETIMES EXPLODE?

H.V.—A drawing punch, 5 inches in diameter and 9 inches long, made from 0.90 to 1.05 per cent carbon steel, burst into about six pieces after heat-treatment, the bursting or explosion being accompanied by a loud report. The punch was subjected to the following heat-treatment: It was first placed in an electric furnace having a temperature of 800 degrees F., and was heated to 1450 degrees F., the time for heating being about five hours. Quenching in a bath of salt brine followed, the temperature of the punch being reduced to about 600 or 700 degrees F.; then the punch was placed in an oil bath until cold. Ten days after the heat-treatment described, the explosion occurred. The steel did not show any defects, but it indicated a great amount of strain, and there was a very coarse structure. What caused this excessive strain?

ANSWERED BY ARTHUR MUMPER, WHEELING, W. VA.

In regard to the foregoing question, there is one point that is not clear. It is stated that the punch is made from 0.90 to 1.05 carbon steel; this could be just a plain high-carbon steel or it could be any one of a number of special alloy steels. H. V. should have stated specifically what the steel was. It would have simplified the answer.

My answer is based on the assumption that the steel punch was simply a piece of high-carbon steel. If so, the temperature of 1450 degrees F. was not too high. I have hardened as much as five tons of tool steel in a month's time, and in nearly every case, the temperature has gone beyond 1450 degrees F., and there has been but slight breakage. The steel punch should not have been held in the furnace a minute longer than the time required to bring it up to the predetermined temperature. A few manufacturers of good steel recommend letting the steel soak for a certain length of time, but in the majority of cases, this works injury to the steel.

The critical range of this steel is around 1350 to 1375 degrees F., and at this point, the steel is right for quenching, as far as grain is concerned, but it has been my experience that this temperature is not always the most satisfactory for quenching. I would have done as H. V. did and raise it to 1450 degrees. The punch should not have been placed cold in a furnace already warmed up to 800 degrees F. Figuratively speaking, that is cruelty to steel. Anyone who loves heat-treating would not abuse a piece of good tool steel in that way.

A better method would be to pre-heat the punch to the same temperature as the furnace before putting the piece in the furnace or else to place the cold punch in a cold furnace and heat them both at the same time. After reaching the quenching point, plain water should be used, as brine is the quickest cooling medium known. The punch should be removed from the water while still hot enough to boil water, and placed immediately in a drawing medium heated up to about 325 degrees F., then slowly raised to a point between 350 and 375 degrees, and held there for not less than four hours. After that it can either be cooled down in water or allowed to cool in the air without injury.

Under no circumstances should a piece of hardened steel be taken from the heat-treating room before it is drawn, as the strains set up by quenching must be relieved by drawing before it is safe to handle. Four hours is the least time that should be required to heat such a piece for quenching. Had it been a piece of oil hardening steel, it would have been nothing to wonder at, if it had burst before coming from the water tank. Lastly, tool steel should be heated slowly, so it will have time to expand with the natural growth of grain as it absorbs the heat.

* * *

DRILL SIZES FOR DOWEL-PINS

By EDWARD T. HEARD

The accompanying table gives the sizes of rod stock commonly used for small dowel-pins, and the sizes of the drills required to give press and sliding fits for dowel-pins made from the different sizes of stock. A table of this kind is a useful addition to the workman's handbook or notebook. If desired, a tracing of the table may be made, and blueprints obtained from the tracing and distributed throughout the tool-room and shop.

DRILL SIZES FOR DOWEL-PIN FITS

Drill Size for Press Fit		Dowel-pin, Crescent or Stubbs Gage, Press Fit in Drill Size		Drill Size for Sliding Fit for Dowel-pin	
Gage Number	Diam. of Drill, Inches	Rod Number	Diam. of Rod, Inches	Drill Number	Diam. of Drill, Inches
D	0.2460	1/4	0.2500	1/4	0.2500
7	0.2010	5	0.2040	6	0.2040
15	0.1800	13	0.1820	14	0.1820
21	0.1590	20	0.1610	20	0.1610
37	0.1040	36	0.1060	36	0.1065
40	0.0985	38	0.1010	38	0.1015
47	0.0785	45	0.0810	46	0.0810
55	0.0520	54	0.0550	54	0.0550
59	0.0410	57	0.0420	58	0.0420
68	0.0310	65	0.0330	66	0.0330
73	0.0240	71	0.0260	71	0.0260
77	0.0180	75	0.0200	76	0.0200

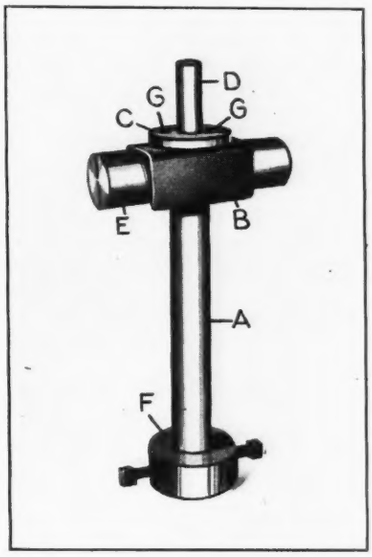
Machinery

ADJUSTABLE RIVETING BAR

By ARTHUR KENDALL

The adjustable riveting bar shown in the accompanying illustration was devised to facilitate the assembling of a part used on a new household appliance. The part, which is shown in position on the riveting bar *E*, consists of a sheet-metal channel *B* riveted to a recessed washer *C* that serves to retain the head of a short shaft *D*. Two rivets *G* are used to assemble the parts. The riveting must be accomplished in such a way as to permit the short shaft to turn freely. The riveting bar can be adjusted by the workman to suit either a sitting or a standing position, and it can be revolved or swung around to conform with the most natural working position for the arms. The bar also provides the best possible riveting surface, as the assembled pieces rest only on the heads of the rivets.

The installation of the adjustable bar was accomplished by boring a hole in the bench and lining the hole with a piece of tubing. The rod *A*, which is a good sliding fit in the tubing, was then turned down at one end to fit a hole drilled in the center of the riveting bar *E*. The turned-down end was then riveted over and finished flush with the top of the riveting bar. Next a collar *F*, with two pointed set-screws, was made to fit the upright bar. The rod was spotted in two places to receive the points of the set-screws in order to facilitate locating the bar for either a sitting or a standing position. This adjustable feature is greatly appreciated by the workman, as he does not become so fatigued when his work is so arranged that he can change from one position to the other at frequent intervals.



Adjustable Riveting Fixture

* * *

MILLING OFF SIDE OF HEXAGONAL ROD

By B. J. STERN

The milling fixture shown in the illustration is employed in flattening or milling off the sides of brass hexagonal rods to the shape shown by the cross-section at *W*. The hexagonal rods are 10 feet long, and the entire length is required to be machined to the dimension *X*, which must be held to fairly close limits. Block *A* has a half-hexagonal groove milled across it to fit the rod. Plate *B* has a corresponding groove in it, so that when it is fastened to block *A*, the hexagonal rod *H* is a close sliding fit in the hexagonal hole. As the hexagonal rod is fed through bearing *C*, it passes the end-mill *D* which cuts away one-half of the section of the rod. The remaining section passes through the bearing *E*, which is formed by a flat plate *F* secured to the block *A* over the hexagonal groove. The rod is thus provided with a bearing support both before and after it passes the end-mill.

The fixture is clamped in a vise *G* on the milling machine table. The rod is fed past the end of the cutter by hand. When the length of the rod projecting from the bearing *C* becomes too short to permit it to be pushed past the end-mill, the operator simply grasps the machined end of the rod and pulls it through the fixture. With the milling machine cutter spindle running at the highest speed available, and using a sharp end-mill, the rod can be fed through the fixture quite rapidly.

* * *

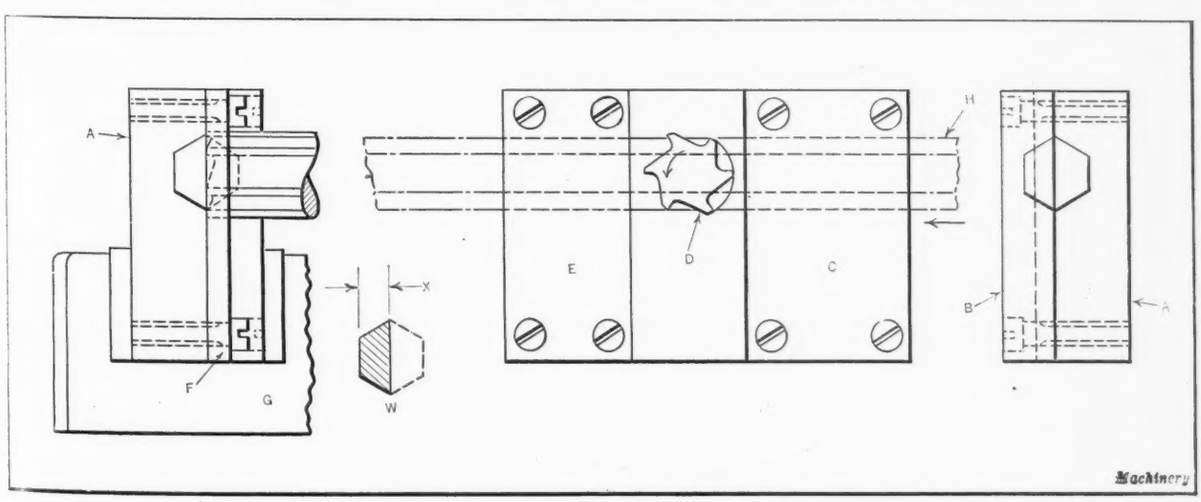
NATIONAL AUTOMOBILE SHOWS

The National Automobile Shows will be held in New York, January 8 to 15, and in Chicago, January 29 to February 5. At these shows, forty-five different makes of automobiles and nineteen makes of trucks, in addition to several taxicabs, will be exhibited. For the first time, the shows will include an exhibit of repair shop equipment. It is expected that this section will be of exceptional interest not only to owners of service stations, repair shops, and garages, but also to individual owners. The accessory exhibitions will include some of the latest devices, as well as the standard lines of well-known products. Considerable interest is evidenced this year in the exhibition of light trucks. Business men visiting the shows will have an opportunity to obtain facts not alone on the engineering features of commercial vehicles, but also on the different types of service for which they are adapted and their operating costs.

* * *

CONVENTION OF MANAGEMENT ASSOCIATION

The American Management Association, with headquarters at 20 Vesey St., New York City, held its fall convention at the Hotel Statler, Cleveland, Ohio, October 11 to 13. Different sessions were devoted to specific subjects; one, intended mainly for sales executives, dealt with trends in methods of distribution; another, for office executives, dealt with methods of computing and charging costs of office operations, the measuring of office output, personnel records, and attendance in office work. One session was devoted to budgeting technique, and another to management's contribution to the national welfare.



Milling Fixture used in removing Half-section of Hexagonal Rod

One Way of Hiring Help

By GEORGE P. PEARCE

THE general manager was an old Scotchman. He had built up the business very slowly but very surely. There was no high finance nor any smart tricks about his methods—delivering a first-class product at a fair price was his law. At times he seemed to lose customers because he would not shave the price a little, but they nearly always came back, for they found a dependable and consistent product worth its price in the long run.

To make good goods one has to have good workmen and a loyal organization, and John McDonald, for that was the general manager's name, selected his men with great care and afterward watched them with even greater care. He was out in the shop among his men much of the time, talking with them, offering suggestions and advice, and, when necessary, criticizing.

As with many well established concerns, it seems as though business is improving very slowly, and then suddenly the customers wake up and the capacity of the plant is taxed to the limit. Improvements are rushed, and in the hustle and bustle of new buildings going up, customers yelling for shipments, foremen and departments being asked for promises of delivery, and the usual breakdowns and delays, everything is chaotic. At any rate this is what the board of directors thought, so they started and investigation to find out what was wrong with what had always been such a smooth-running efficient organization.

Conclusions were quickly arrived at, and the gist of the report was that McDonald was attempting to attend to too many details himself, and so did not have enough time to look after the bigger things. McDonald, however, did not think so, but he did not say very much; in fact, he never was much of a talker—he let the other man do all the talking and he did the thinking.

The board of directors decided that the thing to do was to hire an expert or two who would be able to relieve the general manager of some of the things that were taking a lot of his time, so he would be able to watch the industry in a more general way. To do this would require a lot of tact, for McDonald would not stand for much interference with his methods. The spot the board decided to attack first was the employment office, for it was there that McDonald was putting in much of his time; an efficient employment manager there could do just as well. How to get him there, of course, was a problem. One of the board members knew of an employment man with another concern in a nearby city who was reported to be a shark at the job—this man, he said, could take an applicant, and after a short investigation, decide where he was best fitted to work, and he would put him there even if it was not his present trade. It was efficiency plus.

A plot was laid and a scheme was hatched, and about a week after this meeting, a member of the board dropped into John McDonald's office casually, and during the conversation remarked that there was a Mr. Jacob Slocum for whom he had high regard, particularly for his business acumen, whom he thought he might want to have associated with him some time on some business venture. However, he would like to have him tried out, particularly on his knowledge of men, and wondered if it would be possible for McDonald to use him as employment agent for a little while, where he could watch him and later on report on his ability. For a moment John McDonald said nothing, but looked so straight at the board member that he thought the fireworks were just going to begin, but he was mistaken, for J. M. broke into a smile and agreed to everything, and thus the deal was put over.

Two weeks later, a tall thin man, with a sharp face and a heavier voice than would be expected from his appearance, called and announced that he was Mr. Jacob X. Slocum, and wished to see the general manager. The young lady at the information desk informed him that Mr. McDonald was out of town at a convention and would not be back for probably a week, but Mr. Dale would take care of him. Mr. Dale took Mr. Slocum around the plant and introduced him to the boys, finally installing him in the employment office at a brand new desk, and telling him that he was to start in immediately at his new duties.

There are many ways of hiring help. Some men depend mainly upon their intuition and judgment of men in selecting employes, and require but a bare outline of the previous experience of the applicant. Men with good judgment have been quite successful with this method. Other plans are based upon elaborate application blanks requiring answers to numerous questions. These methods too, when applied with common sense and judgment, have proved successful. Of recent years, the hiring expert has entered this field, and in many instances he has not been so successful as he has led others to believe that he would be. The story related here is an amusing example of what might happen when this type of expert is given a free hand. The most interesting part of this story is that it actually happened.

Mr. Slocum's methods of hiring a man were rather peculiar. After having received a list of the help that was wanted, he would take a walk in the hall where the various applicants had to sit. Staring up and down the line for a few minutes, he would suddenly point at some man and say: "You—Follow me." An interview would follow that was all one-sided, for the applicant was not allowed to volunteer any information, but had to confine himself simply to answering the questions asked. Finally, if satisfied, J. X. Slocum would say: "You are the man I want for such and such a job; it is your natural vocation, and no matter what you have recently been employed at, you should do better at this particular work—you will do better at this work, if you will simply apply yourself to your job. We will try you out for a week or so, and if you show constant improvement, your job will be permanent; if not, you will be let go, for we have no other job in which you will fit."

The new man was then taken to the foreman who was instructed to report back to the employment office twice a week on how the man was progressing. Thus carpenters became punch press operators, blacksmiths found themselves on a gang drill press, and roustabouts would become oven tenders, with the foreman doing most of the work. The foremen had been told that they should give every man at least two weeks trial, and as the new employment man had only been there four days there was very little said.

There were about a dozen applicants in the hall the next morning before the employment manager arrived; in fact, he was a little late that morning, as he had run out of gas on the way down and had to walk half a mile to a gas station and back to get going again. The list of "help wanted" was on his desk, and it called for eight men this time, as a new department was starting up requiring five men and three were wanted for general departments. Right away the "You!—Follow me" started up, and in a short time six men were picked. On the next trip, there was a little delay, but

finally an oldish quiet looking man answered to the "You!—Follow me" call and the interview started.

"You are in good health and physically fit?" asked J. X. Slocum.

"Yes Sir," was the reply.

"Let me look at your hands. Walk twice round the office. Do you use tobacco?"

"I chew a little occasionally," was the quiet reply.

"Read a line of this small type out loud."

After an adjustment of spectacles, this was done.

"Write the first two lines of this paragraph in ink on this piece of paper; use that pen and ink."

This was done, and the writing was legible but rather small.

"Here are three simple examples in arithmetic—one addition, one multiplication, and one division—do these while I time you."

They were correctly done in about normal time. A few more similar questions were asked, and finally Mr. Slocum said:

"We want a man in our lumber yard to pick out the lumber on requisition, mark it with blue chalk, put it on the truck, add up the board feet, subtract it from the stock records, and turn in a report every week—also receive incoming lumber and pile that. You are the man who can do that job. If you take this position, write your name and address on this card, together with the nearest telephone number so that we will know whom to call should you meet with an accident. If you do not want this job, we have no other to offer."

"But don't you want to know something of my experience?" asked the man.

"Quite unnecessary—I know enough about you to know your limitations now."

"Do you think I could get a better position later on—say, a foreman or gang boss?"

"No! You have no executive ability. You are not that type; if you were, you would have risen as soon as I came into the hall, and pushed yourself ahead of the others and forced yourself to be noticed."

"Could I get an office job?"

"Certainly not; your hands are too coarse and your fingers too thick. You have had practically no office experience—your back is too straight."

"You can't give me much encouragement for the future then?"

"No, I am sorry, but you were not built that way; in a few more years you will probably be a watchman or a caretaker."

"Thank you, I do not want that job. Good day."

Mr. Slocum did not reply. He was a little sore, for he rarely had a man refuse a job, especially if he was past fifty. He went into the hall, and soon his "You!—Follow me" was heard again.

On Monday morning the general manager was back in his office from the convention, and before he was through looking at his mail, the board member came in to see him. After a short talk about the convention, he remarked that Mr. Slocum had arrived last Tuesday, and was quite busy on the job. He would go bring him up and introduce him.

"Don't bother," said John McDonald. "I have met the gentleman; in fact, I met him Saturday morning, and he tried to hire me on the yard labor gang. He hasn't got brains enough to ask a man what his name is, who he is, or what he wants. He isn't even civil. He tries to squeeze a man into a job he has vacant, and threatens him if he objects to the fact that there is no other job. Then he makes the foreman hold the man two weeks, and, of course, in that time, most any man could do simple work—then he brags of his wonderful analysis of human nature. Here is an envelope containing Mr. Jacob X. Slocum's salary for one month and his notice of discharge. You can take it down to him if you want to."

John McDonald is still in supreme control, business is excellent, profits are steady, and the board of directors have not again attempted to interfere.

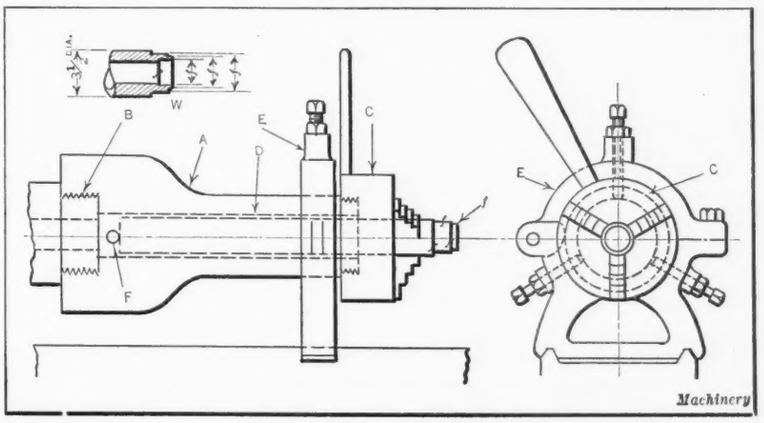
* * *

TUBE-HOLDING CHUCK FOR TURRET LATHE

By B. J. STERN

A turret lathe set-up that may interest MACHINERY's readers is shown in the accompanying illustration. A piece of Shelby tubing *W*, 3 1/2 inches in diameter and 36 inches long, was required to have two shoulders turned on the outside, and one shoulder turned on the inside of one end, as indicated in the illustration. As there were thousands of these tubes to be made, and as the largest turret lathe had a bar capacity of only 2 1/2 inches, an adapter *A* was made to hold the pieces.

The adapter was threaded on one end to fit the spindle nose *B* of the turret lathe, and on the other end to fit a three-jaw Baker wrenchless chuck *C*. A hole *D* was cored in the adapter casting of sufficient size to admit the tube to be machined. The casting *A* thus served as an extension for the turret lathe spindle. As the extension *A* had considerable overhang, the outer end was turned down for a short space close to the chuck and a steadyrest *E*, clamped to the ways of the lathe, employed as a support at this point. The tube to be turned was chucked in the usual manner, a stop *F* being employed to locate the work in the proper position for turning the shoulders. Standard tools held in the turret were employed for the machining operations.



Chuck and Steadyrest used on Turret Lathe

* * *

Men who have thoroughly investigated the present business structure do not agree that installment selling is an objectionable feature in the present business situation. On the contrary, installment selling of various commodities has had much to do with the country's prosperity during the last few years, according to a number of speakers at Babson's National Business Conference held a few weeks ago. Among those who voiced this opinion were William T. Foster of the Pollak Foundation, and Edwin C. Vogel, vice-president of the Commercial Investment Trust Corporation. Without installment selling, it was stated, it is doubtful whether the country would have been able to stave off a serious business depression. Installment buying, when applied to products having a reasonably permanent value, is merely extending to the business transactions of the individual the principle of "funding," that has been universally applied to business, as well as real estate buying, in the past. Installment buying has also an important sociological effect. It permits many to enjoy luxuries formerly denied them, and as these luxuries can be enjoyed only by the fulfilment of certain obligations, installment buying tends to produce stability in industrial relations and to reduce labor unrest.

WATER-WHEEL CASING REPAIRED BY ELECTRIC ARC WELDING

An electric arc welding operation was recently performed at the paper plant of the Parker Young Co., of Lincoln, N. H., that saved the company approximately $800 and completed the job in eleven weeks less time than would otherwise have been possible. A cast-iron water-wheel casing was badly in need of repair. The water-wheel bearing had become worn, and the wheel had moved over so that a section of the casing had been worn away. The worn section was about 10 inches wide and 3/4 inch to 1 inch deep around the inside of the

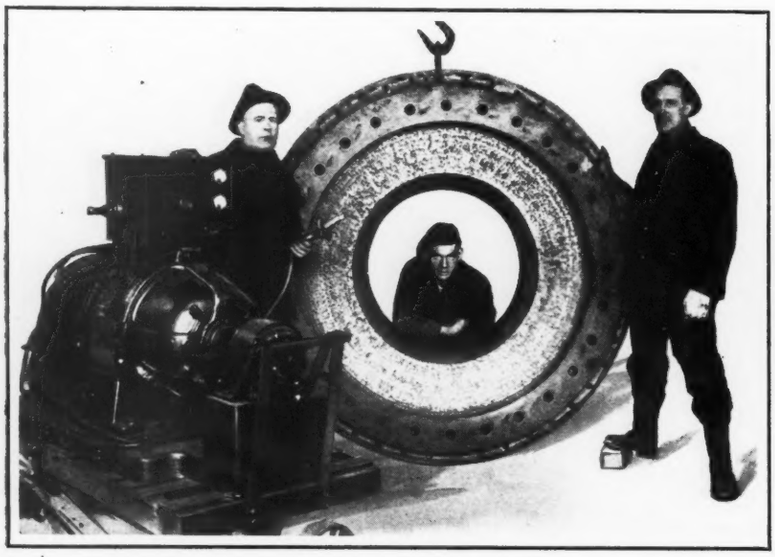


Fig. 1. Arc Welding Apparatus and Water-wheel Casing repaired by filling in Worn Inner Surface

casing. In some spots the casing was worn away entirely, and in others the thickness of the original metal was only 1/32 inch. Some holes up to one foot long had been covered by a patch on the outside.

With the aid of a Westinghouse 200-ampere, three-phase, 25-cycle, 550-volt, portable arc-welding set, this casing was repaired by welding (see Fig. 1). The very thin section and the part that was entirely worn away were first spanned by circular hoops of steel rods, as shown in the diagram, Fig. 2. The first hoop *A*, made of rod 5/8 inch in diameter, was welded to the casting. Hoop *B*, of 5/8-inch rod, was welded to hoop *A*, and then hoop *C*, of 3/4-inch rod, was welded to *B*. Hoop *E*, of 1/2-inch rod, was next welded to the casting itself, and hoop *D*, of 5/8-inch rod, was inserted in the place left between hoops *C* and *E* and welded to these hoops on each side, thus bridging over the weakest part of the casing. The rest of the worn section was filled in, and the surface of the casing ground to a smooth finish by means of a portable grinder.

The striking feature of this job is that it was completed in seven days, at a cost of approximately $200, whereas a new casting could not have been delivered for at least three months, and would have cost about $1000.

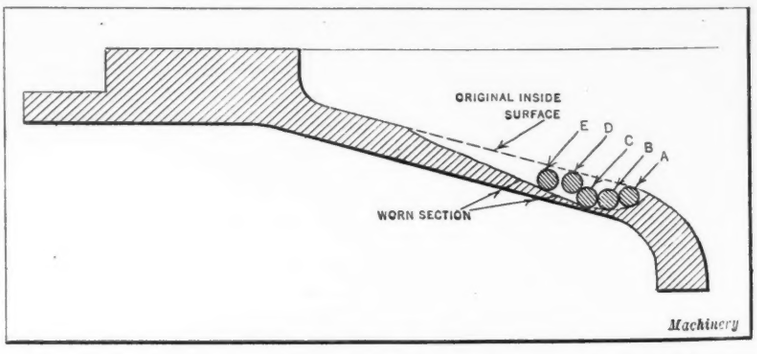


Fig. 2. Half Section of Casing, showing how Five Steel Hoops were used to fill Thinnest Part by welding Hoops together and to the Casing

* * *

Regular passenger air service between Egypt and India in connection with the steamship service from England to Egypt will be inaugurated early next year. This service will be operated by the Imperial Airways, a British corporation, and will be subsidized for the first five years by the British Government. The service will be fortnightly, and the distance covered will be 2500 miles from Cairo in Egypt to Karachi in India. The fare will be about $360 for the total trip, covering all expenses including accommodation at night, when flights will not be attempted.

EFFECTS OF HAND-TO-MOUTH BUYING

In a recent number of *Printers' Ink*, W. F. Gephart, vice-president of the First National Bank, St. Louis, Mo., reviews the effects of "hand-to-mouth" buying. In the first place, it is transferring, to a greater degree, the risks of manufacturing and merchandising to the shoulders of those best able to carry them. It is relieving the retailer of a part of the business risk which he has formerly borne and putting it back on the wholesaler and manufacturer, who are more intelligent, better informed, and, therefore, better able to carry the risk at less cost than the retailer has done.

In the second place, small-order buying has enormously reduced the volume of shelf-worn and out-of-date merchandise which, under the older system, sooner or later had to be sold at a sacrifice. This entailed not only immediate losses to the retailer himself, but ultimately losses, though perhaps indirect, to the manufacturer, the distributor, and society at large.

In the third place, this more rapid turnover of goods, for reasons already suggested, means a more effective use of capital in business and hence an economic advantage which ultimately is shared by the public, including not only the consumer but the producer and distributor.

In the fourth place, this new method means an increased competition in merchandising, and hence will demand more intelligence and better business organization.

In the fifth place, the economic gains of having raw products turned into finished goods and into the hands of consumers as quickly as possible are enormous. By keeping inventories of manufacturers, wholesalers and retailers small, an enormous sum of capital is released for other industrial uses and the whole system of production and distribution is keyed up to a higher pitch of efficiency.

There is no doubt that the war and the post-war conditions accelerated the movement toward small ordering, but it is believed that it would have occurred if there had been no war. This is merely another way of saying that small-order buying and smaller inventories and other phases of the changed order are to be a relatively permanent characteristic of our business and industrial structure.

* * *

STANDARDIZATION PAYS

It is of considerable interest to note that more and more industrial concerns definitely recognize that through standardization it is possible not only to produce cheaper goods, but better. In the machinery field, one company, the Boston Gear Works Sales Co. of Norfolk Downs, Mass., has adopted as a registered slogan the words "Standardization Pays" for use in connection with the company's products of standardized gears, speed reducers, and silent chain drives.

NEW BOYE & EMMES PLANT

Men in the machinery field know that the Boye & Emmes Machine Tool Co.'s factory in Cincinnati was destroyed by fire on January 27; but it may not be so generally known that this plant was a complete loss. It is only by going through the actual experience of clearing away the debris, constructing a new building, and furnishing new equipment that one can recognize just what this task means. The new Boye & Emmes plant, on the same site as the old one, is now in operation, the first lathe having been shipped September 24. Much remains to be done before this factory is in full swing, but things are rapidly shaping themselves in that direction.

As previously stated, the factory building was a complete loss; but the problem of getting business back on an operating basis was greatly facilitated by the fact that all of the original drawings and most of the patterns were in a separate building, so that they were saved. As soon as plans for reconstructing the factory building were under way, work was immediately started on reconditioning such of the gages, jigs, and fixtures as had not been damaged beyond repair by the fire, and on replacing those tools that had been completely destroyed. A force of men was kept at work for this purpose in the warehouse building, which had not been destroyed.

Meanwhile, steady progress was being made with the new factory building. This occupies a plot of ground 90 by 350 feet, which is the same as that of the old plant; but as the present building is laid out so that all floor space is being utilized to the best advantage, the result actually represents the equivalent of substantially increased manufacturing capacity. The building is of steel, concrete, and brick construction, and especial attention was given to the construction of a foundation that would provide a permanent and rigid setting for the machinery and shafting, where alignment could be accurately maintained. A small portion of the machine tool equipment from the old plant was found to be in a condition that justified salvaging, and such work was carried on in the warehouse along with the making of special tools. The greater part of the equipment, however, had to be replaced, and selections have been made with a view to obtaining the types of machines best adapted for the various operations required in building Boye & Emmes lathes.

The illustrations show external views of the factory and office buildings and internal views of the plant. They show that the Boye & Emmes Machine Tool Co. is again in active operation; and before the first of the year it is anticipated that the manufacturing schedules will proceed with their accustomed regularity.

Fig. 1. Boye & Emmes New Factory Building

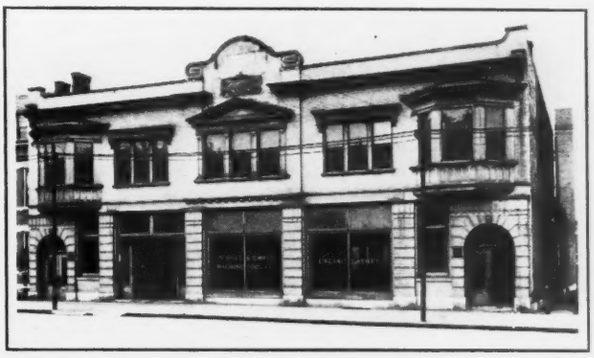


Fig. 2. Office Building and Warehouse

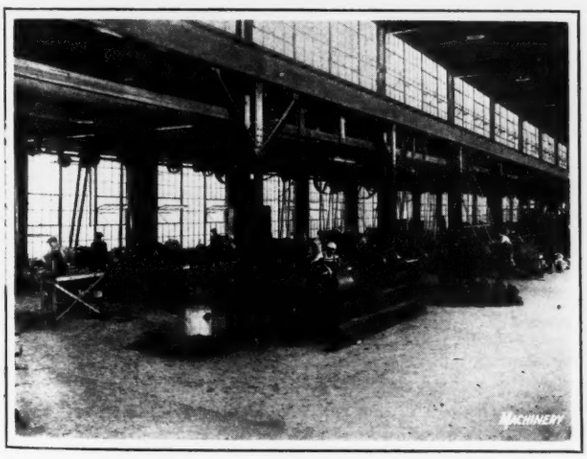


Fig. 3. Interior View of Lathe Department

Fig. 4. Interior View of Planer Department

* * *

THE SWISS MACHINERY INDUSTRY

According to information obtained from the industrial machinery division of the Department of Commerce, the machinery and tool industry in Switzerland leads all others in the country in number of men employed, the total number being 63,750 in 1925. Even the watchmaking industry takes second place, with a total of 43,550 men. The number of men employed in the machinery and tool industry represents 17 per cent of the total number employed in the factories of Switzerland. The exports of machinery from Switzerland amounted to 60,000 metric tons in 1925, valued at nearly $13,000,000, as compared with 52,000 tons in 1924, valued at about $10,000,000. During the first six months of 1926, the exports amounted to over 30,000 tons.

The prospects for the immediate future of the machinery industry, nevertheless, are not considered encouraging. If it were not for the large orders placed by the Swiss railroads in connection with the electrification program now being carried through, there would not be a sufficient volume of business to fill the plants. In the future, more and more of the products of these plants must go abroad. The ability to compete successfully with foreign producers depends on many factors that are beyond the control of the Swiss manufacturers. Materials and wages are high, and it is only with difficulty that the competitive prices of the manufacturers of other nations can be met. To this is added the tariff walls that every nation surrounding Switzerland has erected.

The Machine-building Industries

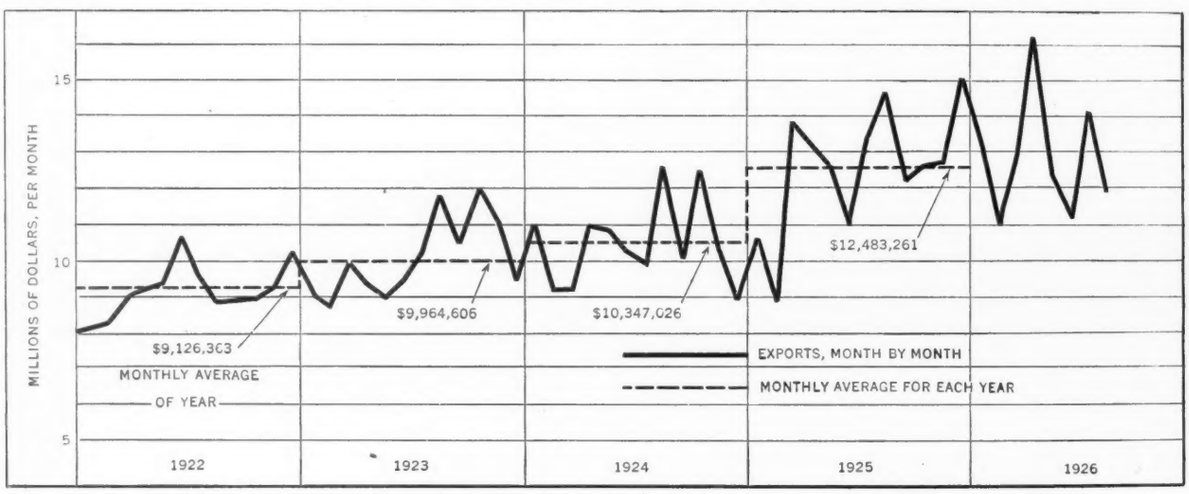
REPORTS of activity in practically all lines of business are favorable. Not only did the industries hold their own during September, for which statistics are now available, but in most instances there was an increase in business. The increases were moderate—a fact that is reassuring to those who know that a gradual improvement is much to be preferred to boom conditions. In fact, there is nothing in the present situation to suggest a boom, but there is much to indicate stable active business for many months to come. Production is largely limited to immediate demand, and buyers place orders only for present requirements. As emphasized by many financial and commercial authorities, the ship of industry will sail with an even keel and make good progress as long as this policy is followed.

The steel output in September was high, and the pig iron production reached a new peace-time record for that month. Unfilled orders on the books of the United States Steel Corporation showed an increase, car loadings are being maintained at a high level, and the earnings of the railroads are increasing. In a survey made by the National Association of Manufacturers, favorable reports were received from 92 per cent of the industrial and commercial firms replying.

The Federal Reserve Bank of Cleveland states that financial, manufacturing, and agricultural conditions have all been favorable, that credit conditions are thoroughly sound, that the iron and steel industry continues to operate at a high level, and that betterment has occurred in many other industries. Retail trade is also greater than a year ago. Present and expected business activity is reflected in several large orders for power generating equipment received by the electrical companies. The General Electric Co. records an increase of 11 per cent in the orders booked during the three months ending September 30, as compared with the same quarter in 1925. The total increase in orders for the first nine months of this year, compared with the same period last year, was about 10 per cent.

Continued Activity Characterizes the Machine Tool Industry

Most machine tool builders state that the demand for machine tools continues active. In September there was a greater volume of new business for the industry as a whole than in any month since October last year. In the larger machine tool plants, at least, the trend of business is still decidedly upward. Some of the smaller plants state that there has been a slight falling off in demand. There was a large volume of unfilled orders on hand at the end of September, with new orders coming in during the early part of October at a satisfactory rate.



Department of Commerce Chart showing Exports of Industrial Machinery from the United States since January, 1922

Activity in Building Field is an Important Factor

There is nothing alarming in the fact that building permits are falling off from the exceptionally high level of the last two years. September usually records a seasonal decrease in new building permits, but a decrease of approximately 10 per cent from August this year and 10 per cent below September in 1925 need not be viewed with apprehension. Furthermore, the figures above, as reported by *Bradstreet's* for 136 cities, include only building permits; more complete reports on building contracts by the F. W. Dodge Corporation, for thirty-seven states east of the Rocky Mountains, show that the decrease was only 6 per cent compared with August this year, and less than 1 per cent under the figures for September a year ago. Furthermore, the total contracts let this year, up to the end of September, amounted to 8 per cent in excess of the building activity in 1925.

Engineering contracts reported by the *Engineering News Record* show a total of approximately $276,000,000 in September this year, as against $243,000,000 in August, and $248,000,000 a year ago. It is explained that the difference between the permits and the contract figures is that the latter include public works and utilities construction, which have greatly increased this year, while the building permits do not record these projects.

Foreign Trade in Industrial Machinery

The exports of industrial machinery from the United States since January 1, 1922, up to the end of August this year is indicated by the accompanying chart. The full line shows the exports, in millions of dollars per month, for each month in the year, while the dotted line shows the monthly average for each full year. In August this year, the exports of industrial machinery amounted to $11,820,610, as compared with $14,687,489 for the corresponding month of 1925. Although these figures indicate a decreased volume for August, it should be remembered that the industrial machinery trade is subject to wide monthly fluctuations. The chart shows that this year one month reached a higher volume of exports than any month since the beginning of 1922. The general trend, year by year, is upward, and there is every likelihood that the monthly average for 1926 will be greater than the monthly average for 1925.

Of the total exports, metal-working machinery in August, 1926, accounted for $1,625,900, compared with $2,150,823 in August, 1925.

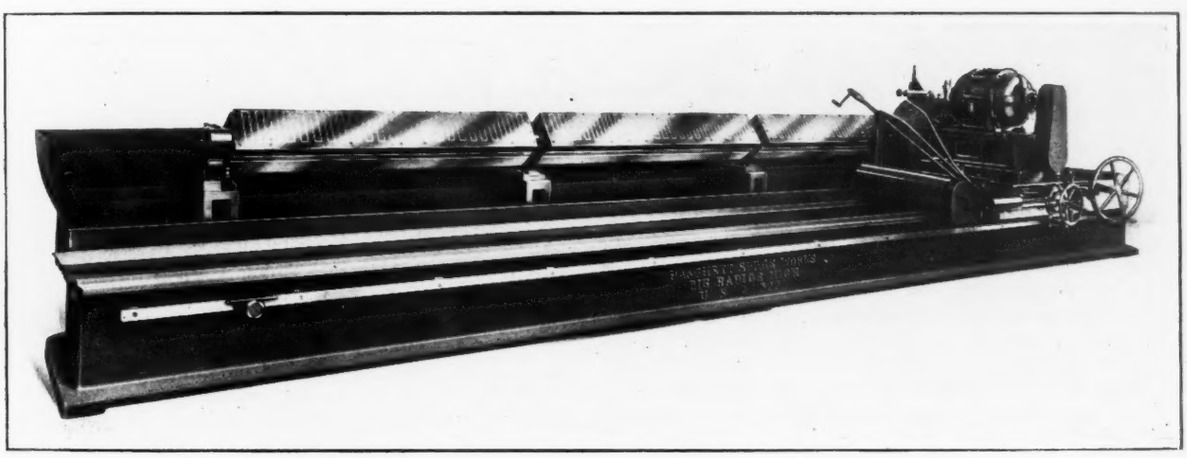
New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

HANCHETT SURFACE GRINDING MACHINE

The grinding wheel of a large surface grinding machine recently built by the Hanchett Swage Works, Big Rapids, Mich., is mounted on a traveling carriage, while the work is held on a stationary table. This machine is equipped with a 220-inch O. S. Walker magnetic chuck, and is primarily designed for grinding locomotive guide bars, shear blades, and similar long work having flat surfaces or edges to be ground. The same type of machine is built in various sizes from 84 inches up to and larger than the 220-inch machine, which is here illustrated. The width of grind ranges up to about 12 inches.

Compactness is an advantage claimed for this construction, the machine being only slightly longer than the maximum length of work to be handled. It is 23 feet long, and requires an operating floor space of about 25 feet 8 inches long by 6 1/2 feet wide. It is also pointed out that because the work-table is always stationary, completed work may be removed and new work mounted on the table without interrupting the grinding. For some classes of work, an indexing work-table may be provided, so that work may be set up on one side of the table while pieces are being ground on another side. At the end of a grinding operation performed on a machine equipped with this type of table, the table would, of course, be indexed to carry the completed work away from the wheel and to bring the new work into position for being ground.



Hanchett Surface Grinding Machine with Traversing Grinding-wheel Carriage and Stationary Work-table

The grinding-wheel carriage is driven through a train of gears which, together with the bed ways, are automatically oiled from a reservoir in the carriage. A pump is not necessary for this lubricating system. The grinding wheel arbor is driven by means of a silent chain from the motor. The arbor is 4 inches in diameter, and is equipped with radial and thrust ball bearings. The carriage may be traversed either by hand or power, and is controllable from both the front and rear of the machine.

Either a 24- or a 30-inch abrasive segmental wheel is provided. This wheel is adjustable to take up wear, and may be readily removed from the machine. New segments can be conveniently installed to replace those worn out. A permanent wheel-truing device is fastened to the upper wheel guard, and the wheel can be readily trued while grinding. The wheel may be fed to the work either by hand or power, and this movement may be actuated from the front or rear of the machine. An automatic feed control is provided which is adjustable for feeding any desired amount. In addition to the other features claimed for this type of grinding machine, it is mentioned that a comparatively small amount of power is required for traversing the grinding-wheel carriage.

ROCKFORD OILGEAR DRILLING AND BORING MACHINE

On the latest drilling and boring machine developed by the Rockford Drilling Machine Co., Rockford, Ill., Oilgear equipment is employed to feed the entire spindle head and drive along the ways of the base. This feed can be arranged for either hand or automatic control, depending upon which method is most suitable for the particular job to be done. Slow feeds in both directions, as well as a rapid traverse, are obtainable with this equipment. The length of travel can be arranged to suit the work.

With a view to obtaining the greatest possible simplicity of construction, minimum number of working parts, and minimum amount of floor space, all gear-boxes have been eliminated from the base of the machine. The motor is so mounted as to drive the head direct through specially designed worm-gearing which gives the desired reduction from the motor speed to that of the main spindle. Speed changes are obtainable through pick-off gears. All shafts and other revolving parts in the drive are mounted in taper roller bearings of ample capacity to withstand all radial and thrust loads.

Either a single- or a double-speed drive is provided for. With a single-speed machine, there are only six gears in the drive, and with a double-speed machine, only eight gears. On a double-speed machine, either speed is obtainable by operating a lever. If both forward and reverse rotation of the spindles are desired, as for tapping operations, one more gear is added in the drive.

The front part of the head or spindle unit is so designed that it can be removed and replaced by another at any time. The spindles run in double bronze bearings located on both sides of the spindle gear. Ball thrust bearings are provided for the spindles. Almost any combination and number of spindles can be arranged for, provided the center distances are sufficient to permit the use of spindles and gears of

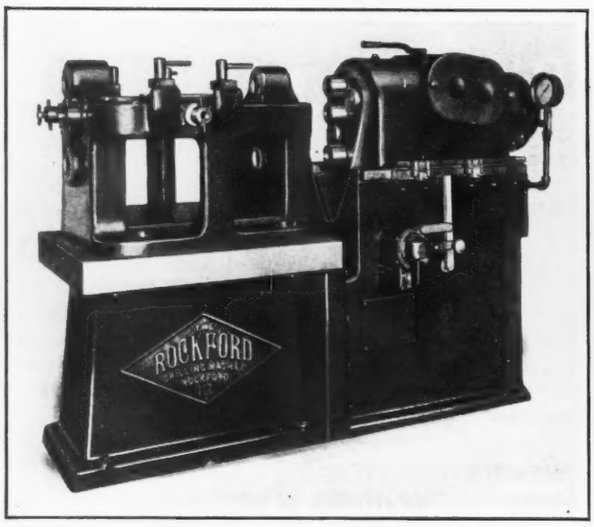


Fig. 1. Rockford Drilling and Boring Machine with "Oilgear" Feed

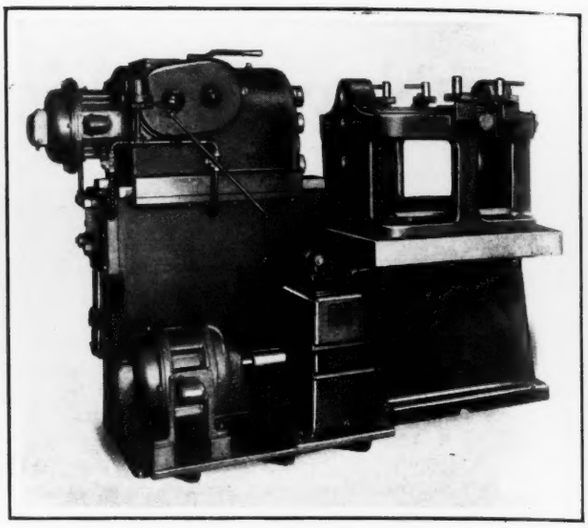
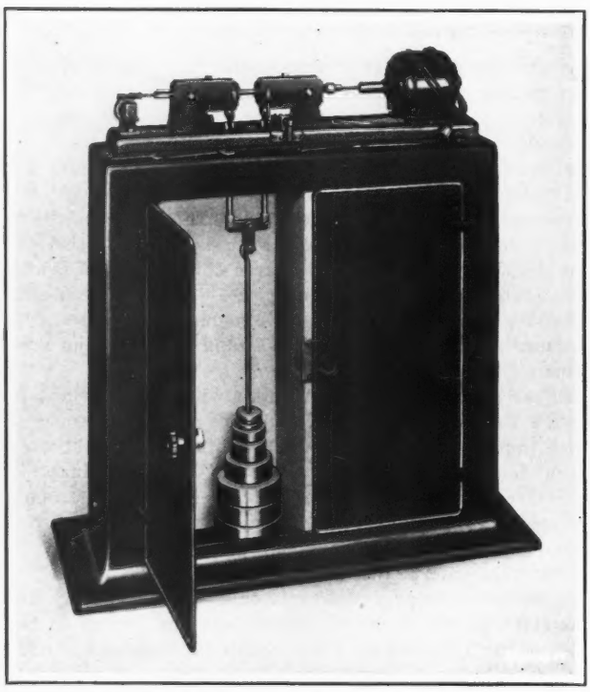


Fig. 2. Rear View of Machine, showing Location of "Oilgear" Equipment

ample size. The spindle unit is made only with fixed centers. The head can be mounted on either a horizontal base, as shown, or on a vertical or angular column. The base can be arranged for a single-end or a double-end machine and with three or four ways. It may also be of a combined horizontal and vertical design. Work-tables may be of a stationary, circular-indexing or cross-sliding type, designed to meet requirements. Several sizes of this machine are built to cover a large range of work.

R. R. MOORE FATIGUE TESTING MACHINE

A machine known as the R. R. Moore fatigue testing machine has recently been placed on the market by the Thompson Grinder Co., Springfield, Ohio, for determining the resistance of metal to repeated stresses, the effects of various factors on the life of metals, and the causes of metal variations in service. This machine is a special design of the rotating beam machine. Among the features of the machine may be mentioned the following: It is provided with plain bearings with a view to insuring quietness and eliminating vibration; has a permanent moment arm which insures accuracy and consistency in the tests; obtains unrestricted beam action due to special features of design; employs a short and simple test specimen; and is readily adaptable to various lengths of specimens.



R. R. Moore Fatigue Testing Machine

The machine consists essentially of two light aluminum housings, each of which supports a journal which is free to rotate. The ends of the test specimen are attached firmly in a tapered hole in the journals. The housings are supported on fulcrum pins, and serve as a mounting for the journal bearings and as a means of applying the load. The load is transmitted to each housing through a hangar yoke, the ends of which are fitted with knife-edges that rest in V-blocks mounted on the housing. Hangar arms attached to the bottom of the yokes are joined at the lower ends by an equalizing bar, from the center of which the load is hung.

The load may be built up in units of 10 pounds and fractions by means of weights which are accurately calibrated. The weights are of a design that facilitates the operation of loading the specimen. The base upon which the machine itself is mounted is a heavy cast-iron cabinet with doors. The weight of the base helps to eliminate the transmission of vibration from surrounding machinery. One side of the cabinet is fitted witth shelves for storing test specimens and with compartments for tools, while the other side, which encloses the loading mechanism, is sufficiently large to contain the weights that are not in use.

There may be a variation in the length of the test specimen from one inch longer than the standard specimen to one inch shorter than standard. Variations between these extremes require no change in the load calculations or in the methods of setting up, which is particularly advantageous in that it permits tests on various shapes, grooved or notched specimens, joints, etc.

The bending moment is uniform over the test specimen, which is particularly advantageous in testing shapes, joints, and other special parts, because the test automatically discloses the weakest point. The calculation of the necessary load for any desired stress is reduced to a single multiplication by a table supplied with the machine. The machine is provided with an automatic throw-out switch, which shuts off the motor when the specimen breaks. Tests may therefore be conveniently run day and night. A recorder counts the cycles of stress passed through the specimen up to the instant of rupture. This recorder is automatically "cut out" when the specimen breaks.

CARBORUNDUM SEGMENTAL WHEEL CHUCK

An improved segmental wheel chuck designed to carry carborundum and aloxite abrasive segments is being placed on the market by the Carborundum Co., Niagara Falls, N. Y.

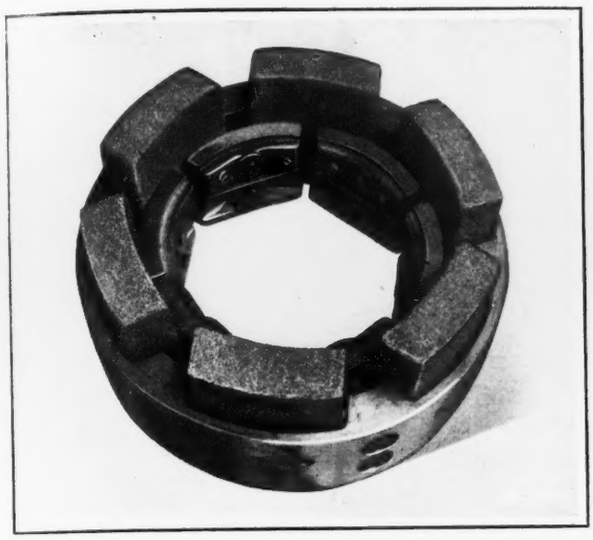


Fig. 1. Chuck built for holding Carborundum and Aloxite Segments

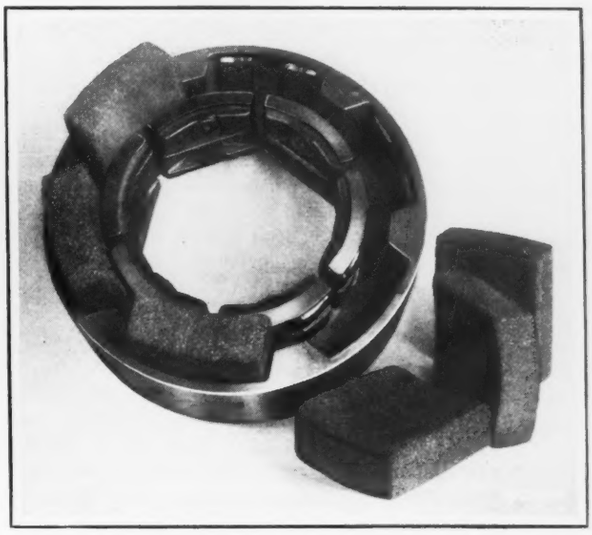


Fig. 2. Chuck with Only Three Segments secured in Place

This chuck is built by the Pratt & Whitney Co., Hartford, Conn., and is intended for use on Pratt & Whitney and Blanchard surface grinding machines. Among the advantages claimed for this chuck are safety and rigidity, obtained by holding the segments in a heavy outside ring; no chipping or cracking of the segments, due to the type of rocker clamps employed; an abundant water supply, properly directed, obtained by tilting the segments outward from the axis; longer grinding life of the segments due to the use of adapters, which cuts down the loss in stub ends; and clamping and adjusting screws of simple design, readily accessible. Another point to which attention is called is the fact that a single size of segment is used for all sizes of the chuck.

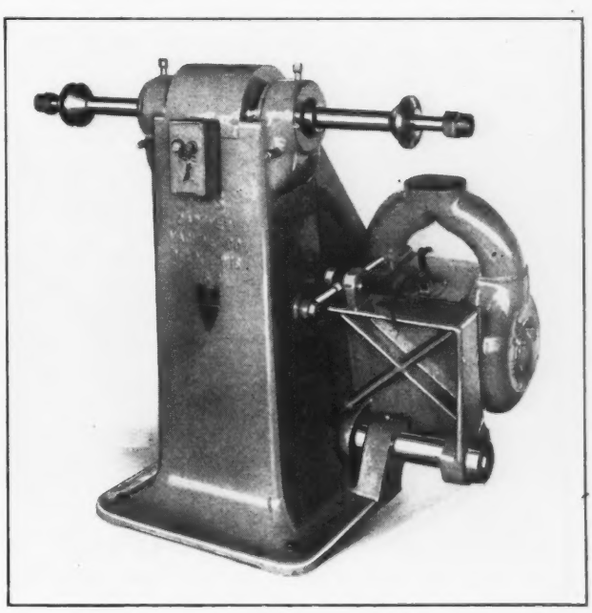
The segments are mounted in pockets inside the chuck body or ring, and are securely held by a series of rocker blocks provided in the chuck body and on the faces of the outer clamps. These blocks automatically compensate for any irregularities in the segments. Each segment is held in position by independent clamps, gripping on both ends. As the curvatures of the outside and the inside of the segments are concentric, any crushing tendency of the ends, and consequent endwise movement of the segments, does not tend to loosen the hold of the clamps.

When new, the segments rest directly on the bottom of the chuck, and when worn and reset in a second position, they rest on top of the inner clamps, which have been pulled forward by means of bolts. In either position, the segments are driven by heavy partitions that are integral with the chuck body. As the centrifugal force and the crushing strain on the segments are absorbed by the chuck body in three directions, the strain on the clamps is comparatively slight. When new, the segments project 2 1/4 inches beyond the mouth of the chuck, and when they rest in the second position, they project 2 inches. Adapters provide still another position for the segments. Worn segments are secured in these adapters by means of a sulphur bond, the adapters permitting segments to be used until they are worn to a thickness of 3/4 inch.

When the segments are tilted outward from the axis, the increased water supply is directed to the point of contact between the segmental wheel and the work, as well as between the segments. The tilting also prevents water from climbing over the wheel guards, and facilitates grinding close to projections on the work. Without moving from his working position directly in front of the machine, the operator can make all necessary adjustments on the chuck, as the heads of all clamping bolts can be brought to him by simply revolving the chuck. All clamping-bolt heads and adjusting screws are below the surface of the chuck, and there are no other outside projections. The segments are 6 inches long, 7 inches high and have a 2-inch face. They are curved to a diameter of 22 inches, and are interchangeable on all chucks from 18 to 30 inches in diameter. From six to eleven segments are used, according to the size of the chuck.

GARDNER MOTOR-DRIVEN POLISHING LATHE

A No. 3-CA special polishing lathe driven by means of an alternating-current motor has recently been brought out by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. The chief feature of this machine is the mounting of the motor on a hinged bracket at the rear of the base. Under certain conditions, this arrangement possesses a number of advantages over the direct-connected machine of this type built by the same company. With the direct-connected alternating-current motor-driven lathe, considerable difficulty is often experienced in obtaining the desired wheel speeds, as a speed of 1800 revolutions per minute is normally considered too slow, and a speed of 3600 revolutions per minute is too fast on many operations. With the new machine practically any spindle speed may be secured, as the hinged motor mounting permits the use of a driving pulley of the required diameter to give the desired speed. This pulley is belted to the machine spindle, the belt being fully enclosed



Gardner Polishing Lathe with Hinged Motor Mounting to provide for any Desired Spindle Speed

with a heavy sheet-metal guard. A motor adjustment provides for taking up all belt stretch, so that the belt will run tight at all times.

In general details of construction, this machine is identical with the standard Gardner No. 3 belt-driven polishing lathe. The spindle is of the same proportions, mounted in ball bearings and enclosed in dustproof housings. Elevated double-capped oil-holes, as well as an efficient lubrication chamber drain, are provided. Hardened steel safety spindle nuts are furnished. A push-button control station is built into the base of the machine, and a starter may be conveniently mounted on a nearby wall.

CLEVELAND OPEN-SIDE PLANER

An open-side planer of new design was exhibited by the Cleveland Planer Co., 3148 Superior Ave., Cleveland, Ohio, at the exposition recently held in Chicago, Ill., in conjunction with the annual convention of the American Society for Steel Treating. This machine, which is shown in the accompanying illustrations, is of the 36-inch by 36-inch by 12-foot size. One of the features is a simple dial feed mechanism located at the right-hand end of the rail. This mechanism can be set for feeding the heads predetermined amounts at either end of the table stroke. Automatic feeds are provided for the heads in all directions, and these can be operated from either side of the machine. All heads are equipped with a power rapid traverse, have taper gibs on their slides, and are provided with clamps of improved construction.

Another point to which attention is called is the fact that the operator can reach all control levers from his normal position. The bed is of much heavier construction than that of former machines, and the pipes of a forced-feed lubrication system run within the bed to carry filtered oil to the vees. This oil is filtered while under pressure after it leaves the pumping unit. Automatic wipers are provided at each end of the bed for wiping the lubricant from the vees of the table at both ends of the stroke. The bed is cast closed on top with full-depth sides.

The table is of box section with rack extended on both ends, and it is so supported that work the full length of the table can be planed. The "Alemite" system is used for lubricating the table and bed vees. The column is also of box form, without any holes in the sides or top, and the column base is cast integral with the bed. The knee, to which the rail is bolted and doweled, is of both plate and box construction, with a bearing of extra length on the column. It is equipped with a single-turn rail clamp, high-speed lifting

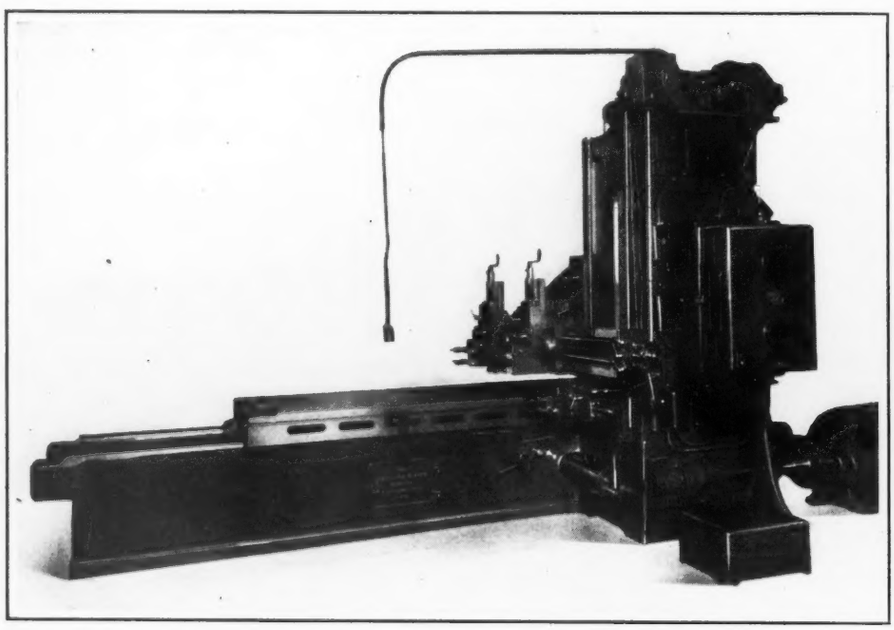


Fig. 1. Cleveland Open-side Planer of Improved Design

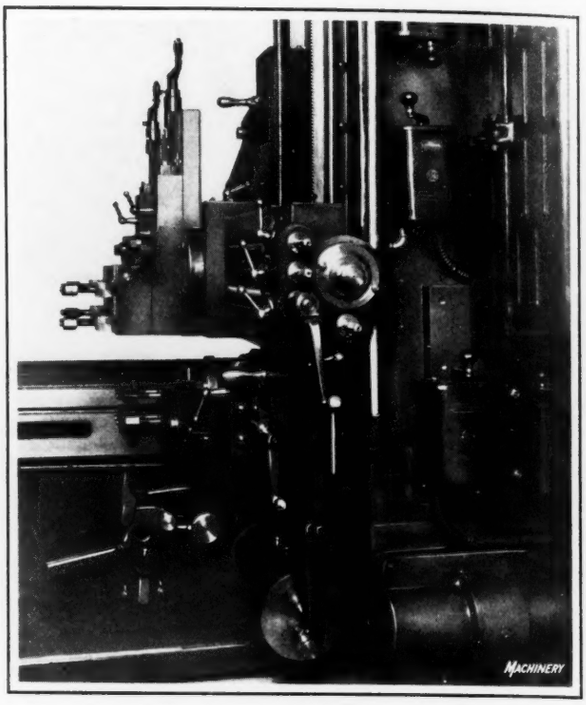


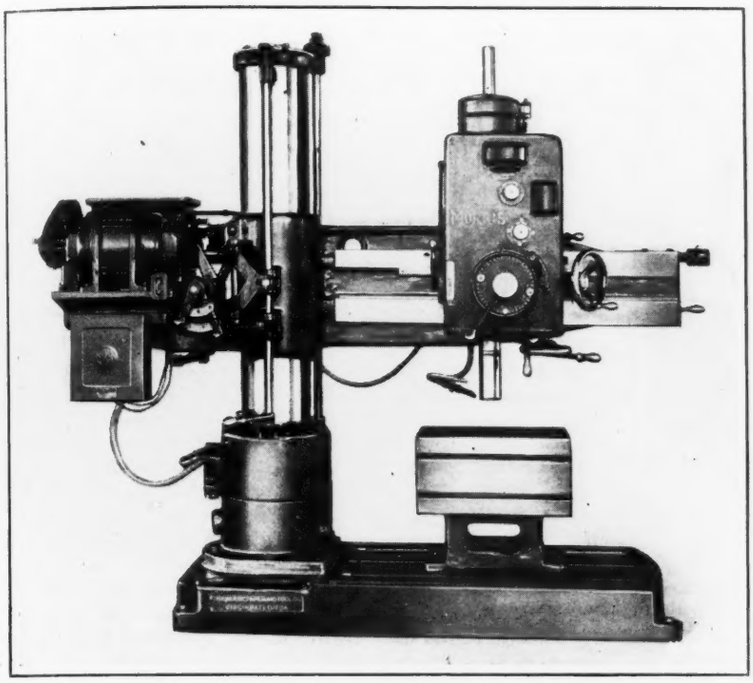
Fig. 2. Close-up View of Open-side Planer, showing the Centralized Operating Levers and the Simple Dial Feed

mechanism, heat-treated steel gears and shaft, and self-oiling "Moccasin" bushings that furnish only filtered oil. An adjusting screw on one end of the rail permits fine adjustments of the rail-head travel. The weight of the machine is approximately 38,460 pounds, including electrical equipment.

MORRIS HEAVY-DUTY RADIAL DRILLING MACHINES

A line of heavy-duty radial drilling machines having the motor drive mounted on the radial arm has recently been placed on the market by the Morris Machine Tool Co., Cincinnati, Ohio. The drive may consist of a constant-speed motor and speed-box or a variable-speed motor. The machines are built in 3-, 3 1/2- and 4-foot sizes. Instead of employing constantly rotating gears on top of the column, for raising and lowering the arm, as in previous designs, the movements are derived from a unit mounted on the back of the arm.

One lever on the head is manipulated to operate two screws for securely clamping the head in position on the arm. Oil is distributed throughout the head from a reservoir located at the top. The spindle is fitted with a ball thrust bearing, and the spindle gear is mounted on a ball bearing. Six feeds ranging from 0.005 to 0.030 inch per revolution of the spindle are available on the 3- and 3 1/2-foot machines. On the 4-foot machine, there are eight feeds, ranging from 0.005 to 0.042 inch per spindle revolution and four thread leads of 8, 11 1/2, 14, and 18 threads per inch. A tapping attachment and back-gear bracket are mounted on the back of the head. The tapping attachment runs in oil, and is equipped with friction clutches of the multiple disk type.



Morris Motor-on-arm Heavy-duty Radial Drilling Machine

The speed-box provided with the constant-speed motor is of the sliding-gear type, and is equipped with ball bearings. The driving pulley is fully enclosed, and is fitted with a friction clutch operated by means of a single lever. The driving pulley runs on ball bearings when the clutch is disengaged. A chart located near the change-speed lever enables the operator to quickly select any of the spindle speeds provided for.

The bearing of the arm on the column is long, and the arm may be clamped in any position by operating a single lever. Raising or lowering of the arm is controlled through the lever at the bottom of the column. This lever accomplishes two purposes; a partial movement causes the arm to be automatically unclamped before the elevating or lowering gears are engaged. Then another short movement of the lever engages the gears for raising or lowering the arm. In bringing the lever back to its central position until a latch catches, the gears are disengaged and the arm clamped. The mechanism is safe, because it prevents the gears from engaging while the arm is clamped. It permits raising or lowering and clamping and unclamping of the arm to be accomplished three or four times faster than with the old method.

The maximum distance between the spindle and the base of the 3- and 3 1/2-foot machines is 52 3/8 inches; and of the 4-foot machine, 60 inches. Eighteen spindle speeds from 36 to 700 revolutions per minute are available on the 3- and 3 1/2-foot machines, and twenty-seven spindle speeds from 24 to 612 revolutions per minute, on the 4-foot machine.

RACINE "SHEAR-CUT" PRODUCTION SAW

An automatic screw-feed mechanism which insures that each tooth of the saw will be given its share of the load is embodied in the "Shear-Cut" high-speed metal-cutting saw recently developed by the Racine Tool & Machine Co., 250-15th St., Racine, Wis. This machine was exhibited at the recent conventions of the American Society for Steel Treating and the American Foundrymen's Association. It is intended for production service.

The screw-feed mechanism progressively draws or feeds the saw into the metal at a certain rate, which is accurately predetermined for each size of stock. Adjustments for various feeds can be made instantly. The feed mechanism distributes the cutting load uniformly throughout the stroke and causes all teeth to enter into the cutting action. In tests conducted by the company on 3-inch cold-rolled steel, the time per cut with former methods increased from 8 minutes for the first cut to 18 minutes for the twenty-fifth cut and 30 minutes for the fiftieth cut, when the blade lasted that long. The new "Shear-Cut" machine cut the same stock in 4 minutes for the first cut, 4 minutes for the fiftieth cut, and 4 minutes for the hundredth cut, and at the end of that time the blade was still good. It is also mentioned that in cutting 6-inch cold-rolled steel the new machine will give fifty or more cuts per blade at the rate of 13 minutes per cut. A standard 1-inch wide blade was used in these tests.

The feed mechanism eliminates all undue blade pressure during the entire cutting stroke, and at no time does the blade bow or buckle. The feeding is accomplished by means of a positive-acting screw. This screw is turned by a cam on the main shaft which operates a radius arm with an adjustable sliding lever that gives the desired feed. Notches in the radius arm indicate the proper feed for each size of stock, and this feed is obtained by placing the adjusting lever in the proper notch. A plate on the machine indicates the proper speeds and feeds to be used when cutting such materials as pipe, tubing, and all solid metals.

The clutch is thrown out automatically, and the feeding device released after the cut is finished by means of an automatic knock-out. This knock-out releases the feeding screw and allows the saw guide to be reset in any desired position. The saw guide is so balanced that it holds itself at any height, giving the operator free use of both hands for resetting and gaging stock for the next cut. The saw is started again by simply throwing in the clutch, and it feeds itself automatically into the work.

The machine is furnished with either a belt drive or a motor drive which functions through direct-connected worm-gearing or a silent chain. A three-speed transmission may be provided for cutting a variety of metals, such as cast iron, tool steel, and alloys of different degrees of hardness. The transmission is mounted directly on the main shaft, and is integral with the worm-gearing unit of the motor drive. It

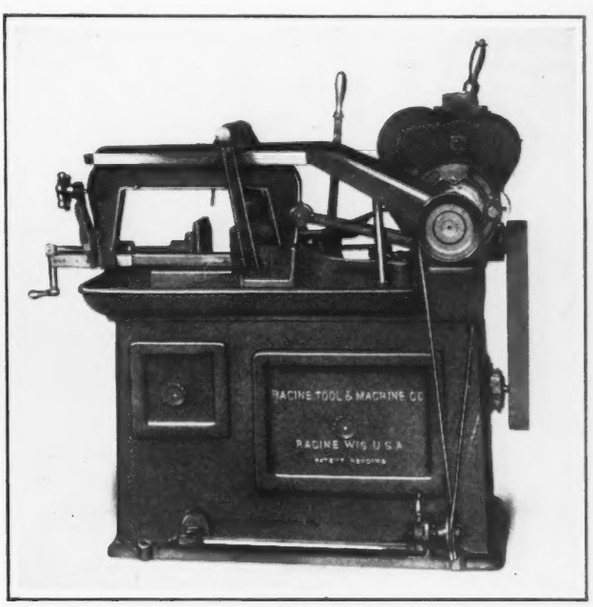


Fig. 1. Racine "Shear-Cut" Metal-cutting Saw for Production Service

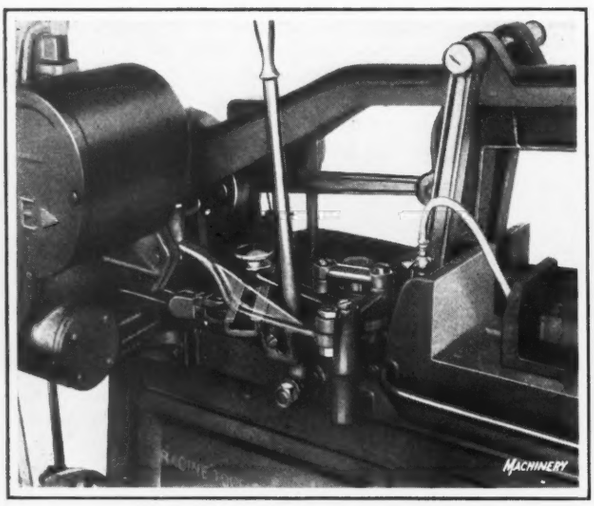


Fig. 2. Adjustable Feeding Mechanism and Compact Three-speed Transmission and Worm Drive of Racine "Shear-Cut" Saw

provides speeds of 60, 90, and 130 strokes per minute. The saw has a capacity for stock up to 6 5/8 inches square in cross-section. The stroke is 6 inches long, and blades 10, 12, and 14 inches long may be used.

HEALD AIR-CONTROLLED SURFACE GRINDERS

On two rotary surface grinding machines recently developed by the Heald Machine Co., 16 New Bond St., Worcester, Mass., air is used to impart instantaneous vertical movements to the work-holding fixture to raise it from the loading into the grinding position and vice versa. With this arrangement, such operations as the grinding of deep recesses in work may be performed with little loss of time for loading and unloading. Figs. 1 and 2 show a machine designed for grinding the inside face or recess of flywheels, and Figs. 3 and 4, a machine developed for simultaneously grinding two surfaces on gear blanks. Both machines are adaptations of the standard Heald No. 22 machine.

The pneumatic equipment of each machine consists of a cylinder mounted on one side of the base, having a piston, the rod of which is connected with two yokes that form a toggle. This toggle, in turn, operates a bellcrank at the left, which has a forked end straddling an elevating screw attached to the chuck. By means of ball-bearing thrust collars, this mechanism raises and lowers the elevating screw and the chuck through a maximum distance of 2 inches. The elevating screw is provided with a long keyway which allows it to slide vertically; this construction permits of using a handwheel to raise and lower the chuck spindle independently of the air mechanism.

Under the piston-rod connection on the toggle, there is a stop adjusting screw which controls the amount of upward vertical movement given to the chuck by the air cylinder. The right-hand member of the toggle has a link connection with members of a start-and-stop lever, which controls the rotation of the fixture and the reciprocation of the ram. This connection provides automatic starting and stopping of the work and the ram at the same time that the chuck is raised and lowered. Complete control of all these movements is obtained by means of a hand-lever conveniently mounted on the front of the chuck guard.

To enable the machine illustrated in Figs. 1 and 2 to finish the recessed surface of the flywheels well back into the corner of the flange, the wheel-spindle is mounted at an angle of 20 degrees relative to the top of the base, and is driven by a direct-connected motor. This construction permits the use of a beveled wheel. The construction of the work-spindle and bearings is such that all end play is eliminated.

The sequence of the operation is as follows: Place the flywheel on the fixture, sliding the front end under the grinding wheel; put the centering plug through the flywheel and lock; turn on the air valve to raise the chuck and start it rotating, and to start the reciprocation of the ram; and use the handwheel to raise the work to the wheel for grinding the surface to the desired dimension. When the work is finished, shut off the air valve when the ram is about 1 inch from the back end of the return stroke. This will allow the ram to coast and stop at about the extreme back position. As the chuck stops and lowers, the operator can readily remove the work.

For truing the wheel, a special diamond device is locked on the chuck bracket, the same as the work. The diamond is so set that the wheel is trued when the chuck is raised. On the side of the machine directly under the reverse box, there is a knurled sleeve having two slots milled in it. When this sleeve is turned so that a pin fits into the shorter slot, the chuck starts rotating as the air is admitted into the cylinder, but when the pin is in the longer slot, the chuck will not revolve when the air is turned on. For truing the grinding wheel, the operator places the pin in the long slot, so that when the air is turned on after the diamond device has been placed on the fixture, the chuck will be raised and the ram will start reciprocating, but the chuck will not revolve.

On this particular job, before raising the chuck for dressing the wheel, the connection between the toggle and the lever employed for starting the chuck and ram can be locked by means of the knurled nut on the rod that connects the toggle with the lever. After the diamond is raised by air into the truing position, the amount taken off the grinding wheel is determined by moving the handwheel between reciprocations of the wheel-slide effected by the hand pilot wheel.

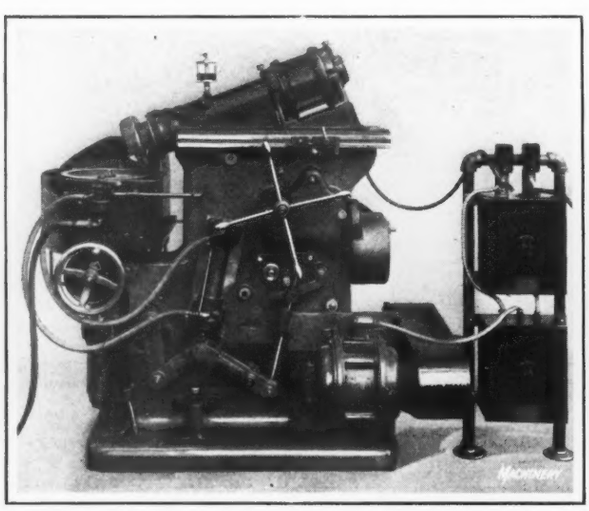


Fig. 1. Heald Surface Grinder operated by Pneumatic Equipment

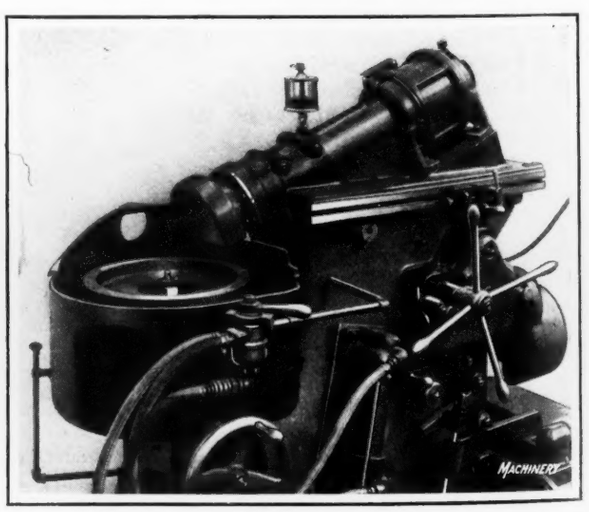


Fig. 2. Machine with Inclined Wheel-spindle for grinding Flywheels

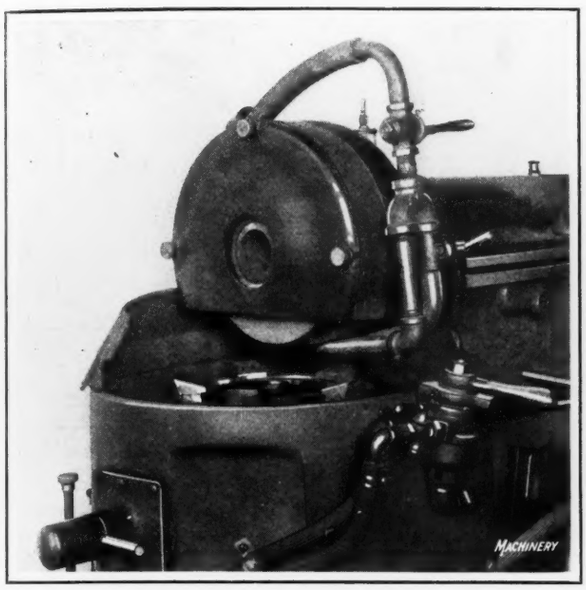


Fig. 3. Air-operated Grinding Machine arranged for simultaneously finishing Two Surfaces on Gear Blanks

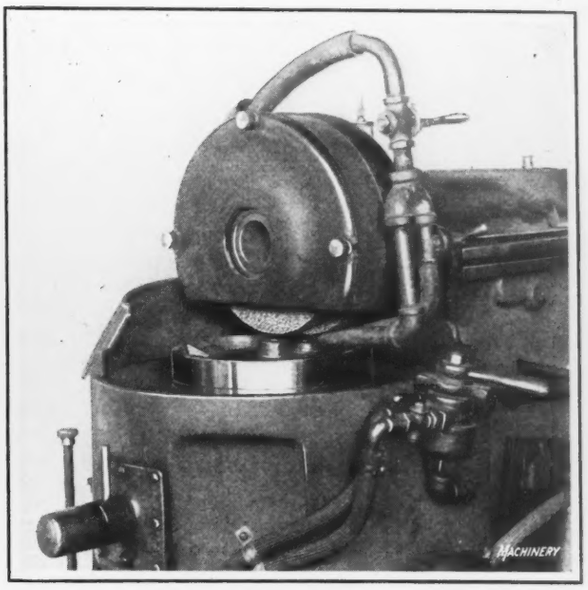


Fig. 4. Using Two Diamonds mounted in a Plate, for truing Both Grinding Wheels at the Same Time

On the machine used for grinding the rim and hub of gear blanks at the same time, the fixture is of a collet type, which automatically closes to hold the work as the chuck is raised into the grinding position. After the grinding operation, when the air has been released and the chuck dropped into the loading position, the collet automatically opens to permit the work to be removed. Two diamonds mounted in a plate are located in the work-holding fixture, as illustrated in Fig. 4, for dressing both wheels simultaneously.

The style No. 22 machine to which this pneumatic equipment has been applied consists, in general, of a base having flat and vee ways for the wheel-slide. The wheel-spindle is of large diameter, and is mounted in straight, plain, adjustable bearings at the wheel end and in a ball bearing at the rear end. The wheel-spindle used on the flywheel machine is of all ball-bearing construction. Power is delivered from the main line to the back-shaft which transmits it directly to the main speed-box, wheel-spindle, and pump. The main speed-box is located at the rear of the machine, and transmits power to the wheel-slide through a three-speed cone pulley and to the chuck through gears which give three speeds. The speeds of the wheel-slide and chuck are independent of each other, the chuck speeds being controlled by means of a pull-rod on the front of the machine.

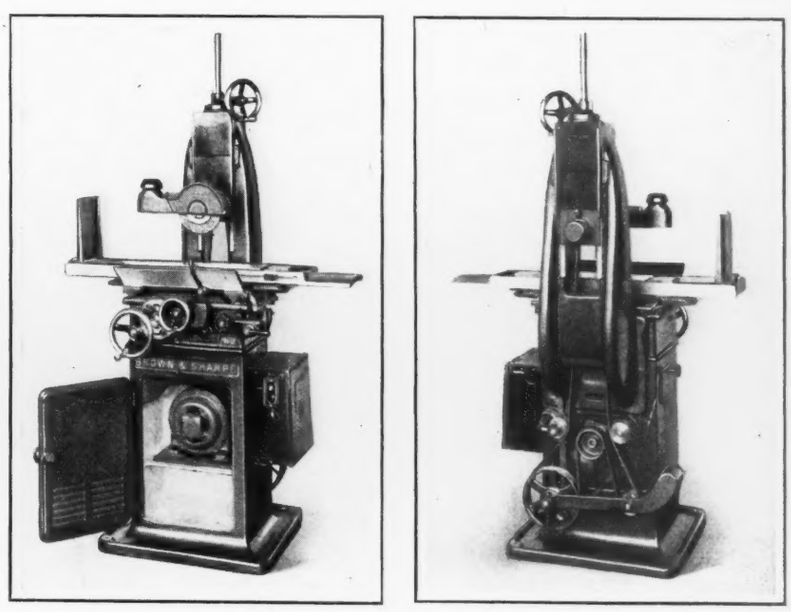
The chuck spindle is mounted in a sleeve which has a vertical adjustment. The upper portion of the spindle rests in a taper bearing, while the lower end is equipped with ball bearings. The machine can be arranged for wet grinding and may be provided with special work-holding fixtures or magnetic chucks. Either a belt or motor drive can be furnished.

BROWN & SHARPE SURFACE GRINDING MACHINE

The latest addition to the line of "complete-unit" machine tools built by the Brown & Sharpe Mfg. Co., Providence, R. I., is a motor-in-the-base No. 2 surface grinding machine. Enclosed within the base, the motor is completely protected from oil, water, dust, dirt, and other sources of trouble to which motors located on the outside of machines are sometimes subjected. Another advantage is that the drive is in a compact and convenient form.

The motor is of the constant-speed type, and is secured to a plate which, in turn, is bolted to a shelf. Ventilators cast in the door provide sufficient circulation of air to insure a cool running motor. The space under the shelf serves for the storage of attachments and machine accessories. Power is transmitted from the motor to the machine by means of a belt which runs over a system of pulleys. A tightener automatically keeps the belt at the proper tension, regardless of the height of the spindle head. The control box is located on the side of the base, with the push-button control in a convenient operating position.

The longitudinal table travel and the transverse carriage movements are automatically controlled. An automatic stop is provided for disengaging the transverse movements at any desired point. A knurled knob on the front of the machine is manipulated to disengage the power cross-feed when only the longitudinal feed is to be used. All controls are conveniently centralized, and vital parts are completely covered by guards which protect them from destructive abrasive dust and thus lengthen the life of the machine. Work up to 18 inches long, 6 inches wide, and 9 1/2 inches high can be accommodated when a wheel 7 inches in diameter is



Brown & Sharpe Motor-in-the-Base Surface Grinding Machine

used. A floor space of 65 by 30 inches is required, and the net weight of the machine without the motor is 1350 pounds. The machine may be equipped with a dust exhausting arrangement; wet grinding attachment; magnetic chuck; and index-centers.

GLEASON TOOTH-SPACING TESTER

Gears of any type can be conveniently checked for accuracy of tooth spacing by means of a tester now being placed on the market by the Gleason Works, Rochester, N. Y. This tester is equipped with an "Optimeter," which constitutes an optical device having a scale graduated to 0.00005 inch. The graduations appear about 1/16 inch apart when observed through the eye-piece of the instrument, and hence, it is an easy matter to estimate readings considerably closer than 0.00005 inch. In Fig. 1, two of the testers are shown mounted on a floor stand which is also built by the Gleason Works to facilitate the application of the tester. The top of the stand is a surface plate which has T-slots in it to permit bolting the testers securely in place.

Each tester has a hinged arm *A* with a slotted extension

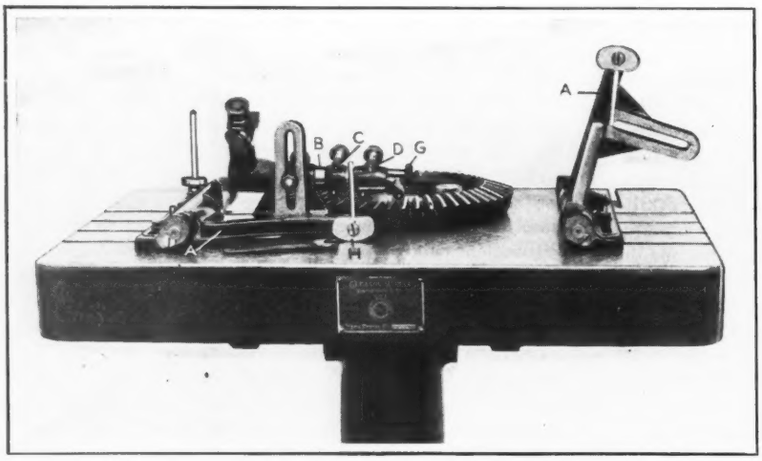


Fig. 1. Device developed by the Gleason Works for checking the Spacing of Gear Teeth

on which the testing unit may be clamped in various positions to suit the convenience of the user. The testing unit consists of a hollow cylindrical bar or tube, on one end of which the "Optimeter" is mounted, as shown at *B*. Holders *C* and *D* are mounted on the opposite end, a stationary finger being fastened to holder *C* and a movable finger to holder *D*. These fingers are shown, respectively, at *E* and *F*, Fig. 2. The stationary finger *E* is used simply as a stop against one side of a gear tooth in an inspection, and the movable finger *F* is brought in contact with the same side of the following tooth. The upper end of finger *F* comes in contact with a rod that extends through the hollow bar and is connected at the far end to the "Optimeter." Hence, any movement imparted to this finger relative to finger *E* is transmitted to the optical device.

In setting the device for the inspection of a gear, the stationary finger is first placed in contact with the side of one tooth, and then holder *D*, Fig. 1, is adjusted by turning knob *G* to bring the movable finger into engagement with the following tooth. The reading of the "Optimeter" for this setting of the movable finger is then carefully noted. Each tooth space of the gear is similarly inspected, and the deviation from the original reading is noted. The handle of cam *H* is moved to a horizontal position between the checking of the successive tooth spaces, to raise the tester fingers from contact with the gear teeth and thus permit the user to index the gear through a distance equal to one tooth space. The fingers are again dropped into the testing position by simply returning the cam handle to the upright position. The spacing of teeth of any size up to about 1 inch in circular pitch can be checked.

A taper hole in the top of the table receives arbors on

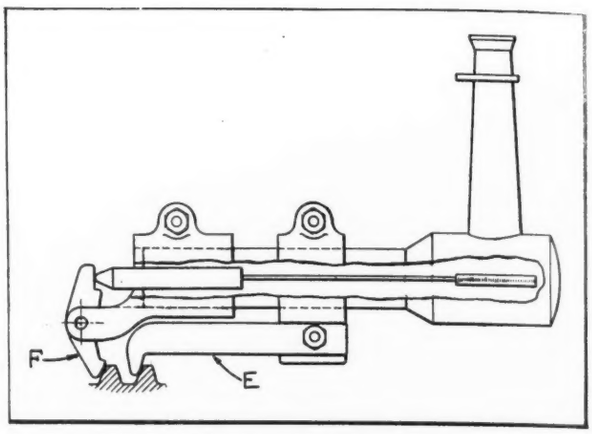


Fig. 2. Diagram showing how Movements of the Movable Finger are transmitted to the "Optimeter"

which gears may be mounted for convenient rotation past the tester. Tapped holes in the table also furnish a means of fastening blocks or disks around the bore of large gears to insure correct rotation of the gears. Special adapters are made to hold the shanks of certain types of pinions.

WESTINGHOUSE BOX-TYPE ELECTRIC FURNACE

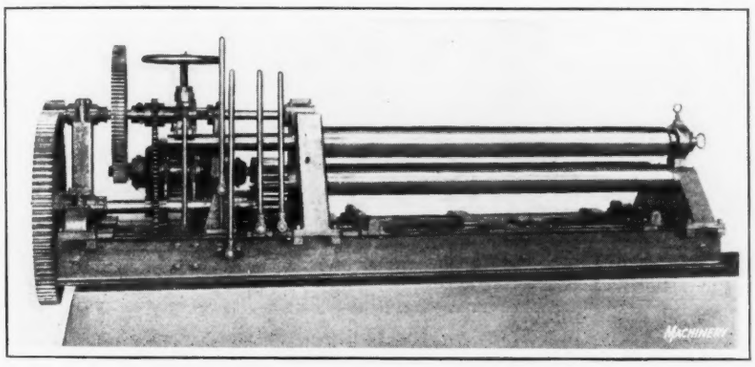
A box or hearth type of electric furnace, particularly applicable to production work in plants for heat-treating machine parts, and to tempering lathe and planer tools, dies, and punches in tool-rooms, is being made by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. This furnace, known as the type H, is constructed of a shell of heavy boiler plate, riveted and bolted to a structural steel frame, and heavy front castings. Heat insulations and the heating chamber are enclosed in the shell. The entire roof is assembled in a frame and bolted to the lower portion of the shell, this construction permitting the roof to be lifted and swung to one side for the inspection or repair of the linings and the heating elements.

Westinghouse Box or Hearth Electric Furnace

The direct radiating heating elements, made of nickel chromium, are protected and open, and are assembled in a frame of the same metal. They can easily be removed if necessary. A cast nickel-chromium floor-plate distributes the heat evenly, protects the bottom element, and forms a smooth surface for handling the material in and out of the chamber. The furnace is automatically controlled within close temperature limits, which can be fixed as desired up to the limit of 1850 degrees F. This automatic regulation of temperature is intended to produce economy of operation by eliminating improperly heated charges and reducing the operator's time in attendance. Three sizes of the furnace are built, having capacities at 1500 degrees F., for 100, 240, and 360 pounds of steel per hour, with connected loads of 15, 27, and 40 kilowatts, respectively.

WICKES PLATE BENDING ROLL

A medium-duty bending roll provided with power elevation for the top roll has just been added to the line of plate bending machines built by Wickes Bros., Saginaw, Mich. Former bending rolls of the same capacity were arranged with a hand raising and lowering device for the top roll, and hence adjusting of the top roll constituted a slow and tedious process. The machine illusrated has a capacity for rolling



Wickes Medium-duty Plate Bending Roll

mild steel plates, 1/4 inch thick and 6 feet wide, into a circle 24 inches in diameter. The machine measures 6 feet 2 inches between the housings, and has a top roll 6 inches in diameter. The bottom rolls are 5 1/2 inches in diameter. There is a balance bar and a "knock-down" end housing which permits the removal of plates rolled into complete circles. The main drive is from a 7 1/2-horsepower motor.

Power for operating the raising and lowering device is taken from the main drive shaft by means of a chain and friction disk clutch. Clutches are provided for each elevating screw, so that either end of the top roll may be raised or lowered independently of the other end to provide for rolling plates into conical sections. The frame of the machine is built of heavy structural steel channels, which are intended to rest on a concrete foundation, with bolts running through the frame and the concrete. In many respects, this medium-duty machine is similar to the heavy-duty bending roll built by the same concern, which is also arranged with a power elevating device for the top roll.

CLARK INDUSTRIAL TRAILERS

A line of trailers designed for use with all power-driven haulage tractors has recently been brought out by the Clark Tructractor Co., Buchanan, Mich. This line includes a caster-wheel trailer, such as shown in Fig. 1, a four-wheel steer trailer, and a fifth-wheel trailer. The caster-wheel trailer is equipped with a patented automatic-hitch coupler, which permits the rapid coupling and uncoupling of long strings of trailers. The lifting of a single steel loop, as shown in Fig. 2, uncouples the trailer, while hitches are made automatically. Coupling and uncoupling may be accomplished without the driver dismounting from the tractor. Still another advantage of the coupler is that it permits the trailer trains to turn sharp corners without unnecessary drag. The platform of the trailer is 3 feet wide, 6 feet long, and 13 1/2 inches above the ground. It is made of 1 1/8-inch hard wood. The trailer weighs 500 pounds, and has a capacity for 2 tons.

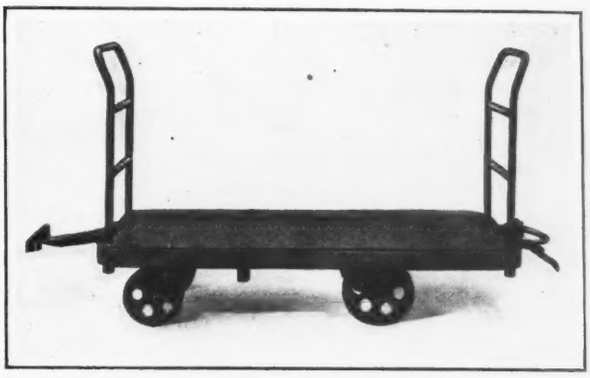


Fig. 1. Clark Caster-wheel Trailer

The four-wheel steer trailer has an over-all length of 7 feet 6 inches and an overall width of 3 feet 6 inches. The platform of this trailer is made of 1 1/4-inch hard wood which is set flush with a channel-iron frame. The platform is 20 inches above the floor. Either rubber-tired or steel wheels can be furnished. This trailer weighs 900 pounds, and has a capacity for transporting loads of 5000 pounds.

The fifth-wheel trailer is intended for carrying loads up to 6000 pounds. It weighs approximately 685 pounds. This trailer is equipped with rubber-tired wheels and a standard steering and coupling tongue. Hyatt bearings are furnished for all wheels. The front wheels are 15 inches in diameter, and the rear wheels, 18 inches. Hard wood, 1 1/4 inches thick, is also used for the platform of this trailer, and the platform is 20 inches above the floor. The trailer length is 6 feet 3 inches, and the width, 3 feet.

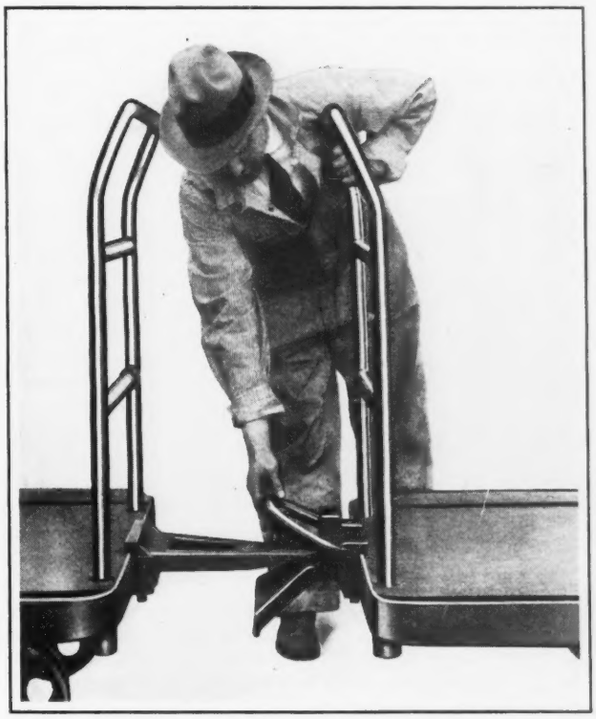


Fig. 2. Automatic-hitch Coupler provided on Clark Caster-wheel Trailer

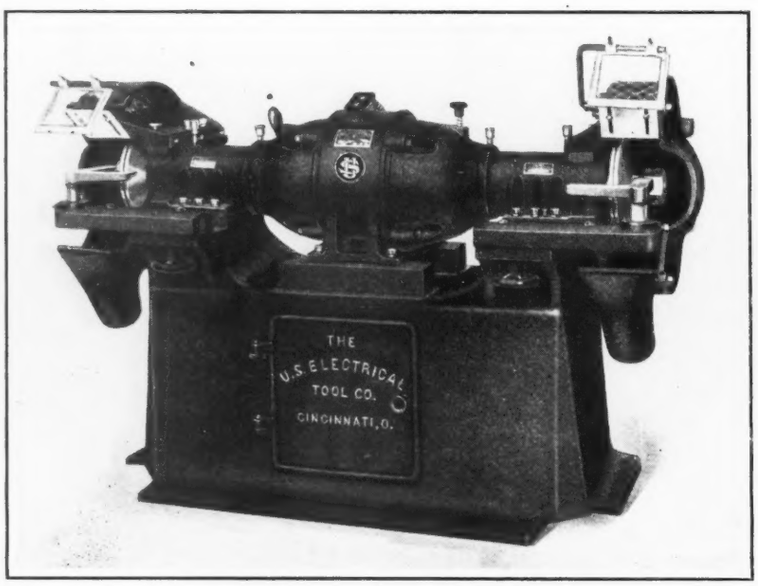


Fig. 1. United States Electrical Adjustable-speed Grinder

U. S. ELECTRICAL GRINDER AND DRILL BRACKET

A heavy-duty adjustable-speed grinder of the construction here illustrated has just been placed on the market by the United States Electrical Tool Co., 2488-96 W. 6th St., Cincinnati, Ohio. This machine may be arranged for operation on 110- and 220-volt direct current, or 220-, 440-, and 550-volt, two- or three-phase alternating current. It has the same general specifications as other heavy-duty grinders built by this company, which were described in April MACHINERY, but in addition, the machine is so designed that adjustments of the wheel guards to suit the wear of the wheel automatically regulate the speed of the motor. Thus, the peripheral speed of the grinding wheel is approximately constant, regardless of the diameter of the wheel.

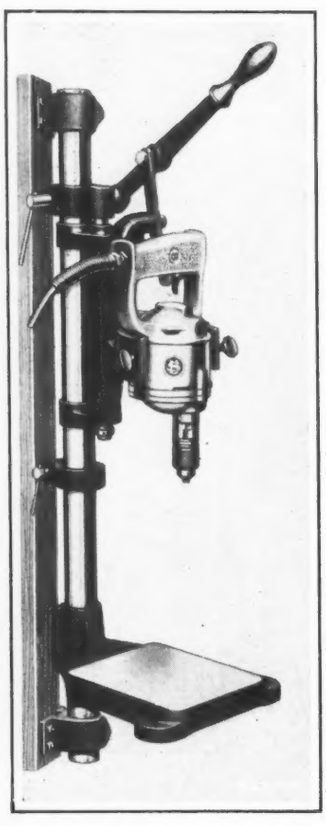


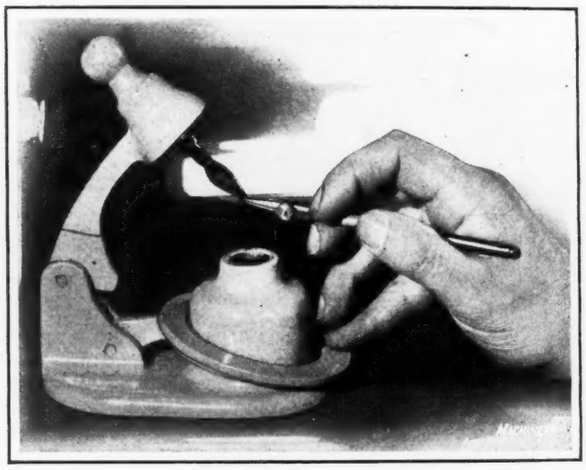
Fig. 2. Wall Bracket for Portable Drills

When the machine is operated on direct current, a constant peripheral speed can be obtained, regardless of the wheel size. With alternating current, starting with a 24-inch wheel running at 900 revolutions per minute, which gives a peripheral speed of approximately 5500 feet per minute, the wheel is used until it is worn down to 18 inches, at which time a speed of 1200 revolutions per minute is automatically cut in by moving the hand-lever. This, again, gives a peripheral speed of approximately 5500 feet per minute. Another change in speed occurs when the wheel is worn to 12 inches in diameter, the motor being then run at 1800 revolutions per minute to give a peripheral speed of about 5500 feet per minute. A new type of base is provided for this machine. This base is also furnished on the machines illustrated in the April number. Four ball bearings are provided on both machines.

Fig. 2 shows a type Q wall bracket for drills, which may be attached to a wall where bench space is limited. This bracket is designed to take care of the 1/4- and 5/16-inch portable electric drills manufactured by this company. The vise-like grip eliminates the use of special adapters. The drill may be raised, lowered, or swung on the vertical column, and secured in any position by tightening the clamping screws. The drill is supported by an enclosed spring.

DRAFTSMAN'S PEN-FILLING INKSTAND

An inkstand that facilitates the filling of draftsmen's ruling pens has been placed on the market by the National Tool Engineering Co., P. O. Box 712, Indianapolis, Ind. This stand is an iron casting that is painted on the inside as well as on the outside. It is finished all over in "Duco Ivory." The bowl is large enough to hold the entire contents of a standard bottle of drawing ink.



Draftsman's Ink Stand manufactured by the National Tool Engineering Co.

and is made in one piece with the body so as to eliminate the glass bottle.

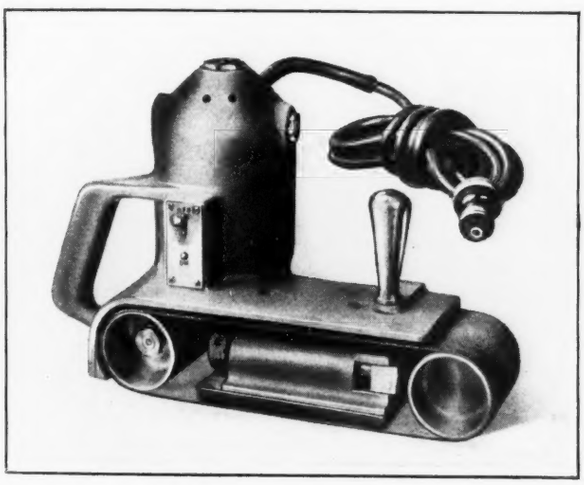
The top member of the stand is heavy enough to keep the bowl tightly closed when ink is not being taken from the bottle, and it can be freely swung upward and held open. This member is provided with a soft rubber pad that fits snugly on the machined surface of the bowl. Instead of the customary quill for filling the ruling pen, a standard steel pen is provided, which can be easily replaced as it becomes corroded. The "Duco Ivory" finish reflects light on the filler pen, so that the draftsman can easily fill the ruling pen without getting ink on the outside of the blades. The filler pen rises about 3/4 inch above the top of the bowl. The weight of the stand is about 3 pounds, and is sufficient to eliminate any chance of the stand being tipped over on a drawing-board.

PORTER-CABLE HAND SANDER

A hand belt surfacing machine known as the "Take-About Sander" is a recent development of the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y. This machine is intended to replace hand-sanding or polishing of wood or metal parts. The operation of the device is similar to the method of using a hand plane. Not only may flat surfaces be sanded by the use of this machine, but concave and convex surfaces as well, since the block over which the belt travels is shaped to suit the work. A flat hard wood block

is regularly furnished, but blocks of other shapes can readily be substituted to suit requirements. Another advantage claimed for the device is that flat surfaces can be sanded without waves, as the portions of the belt over the pulleys do not come in contact with the work.

For sanding interior curves of a radius larger than that of the front pulley, the sander may be tilted or lifted into the proper position. For grinding and polishing large metal surfaces, the machine may be equipped with a flexible pad in place of the solid block, although this substitution is not necessary. The entire frame of the machine, with the exception of the motor cap, is a one-piece aluminum casting, and the motor cap, pulleys, and some other parts are also cast from aluminum. This reduces the weight to 12 pounds, and makes for easy portability. The sander is equipped with a 1/3-horsepower universal motor that may be operated on any alternating-current circuit of from 25 to 60 cycles, or on a direct-current circuit of 110 volts. Motors can also be supplied for operation on 220-volt current. On this equipment, the changing of a belt can be accomplished in a fraction of a minute.

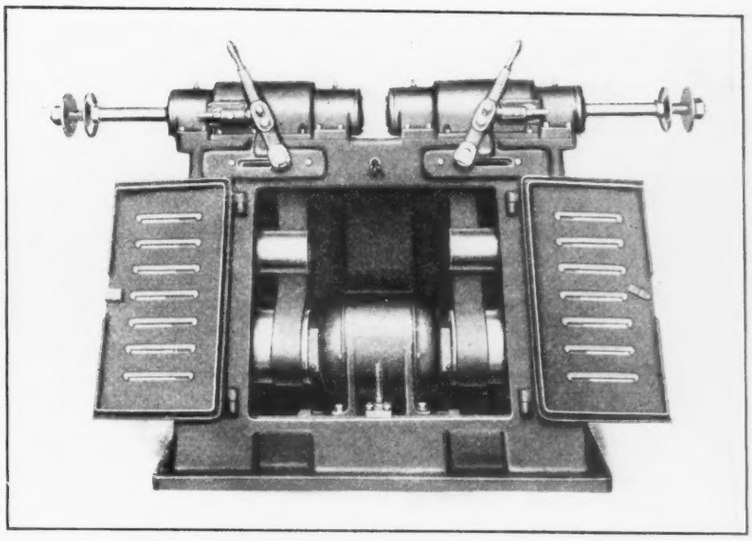


Porter-Cable Hand Sander for Wood and Metal Surfaces

HISEY SELECTIVE-SPEED BUFFING MACHINE

A motor-driven buffing machine having two spindles which may be started and stopped independently of each other is the latest addition to the line of products built by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The individual operation of the two spindles can be readily understood from the accompanying illustration, which shows a rear view of the machine. Belt shifters for the two spindles are mounted directly in back of the spindles. Working in unison with each shifter is an adjustable brake that is engaged when the belt is shifted on the loose pulley, so as to hold the spindle stationary until the belt is again shifted on the tight pulley. The belt tension can easily be regulated by means of adjusting levers at each end of the machine. Further adjustment is obtainable due to the motor being mounted on a hinged platform that is equipped with a screw adjustment.

Two large doors in the rear of the housing permit full access to the interior of the machine. Ball bearings are used throughout the machine construction, there being twelve in all. The bearings are provided with liberal means of lubrication. As in other Hisey products, a full-safety automatic motor starter with a push-button control is standard equipment. If desired, different spindle speeds can be provided for. The machine is built in three sizes for operation by 7 1/2-, 10-, and 15-horsepower motors, respectively.



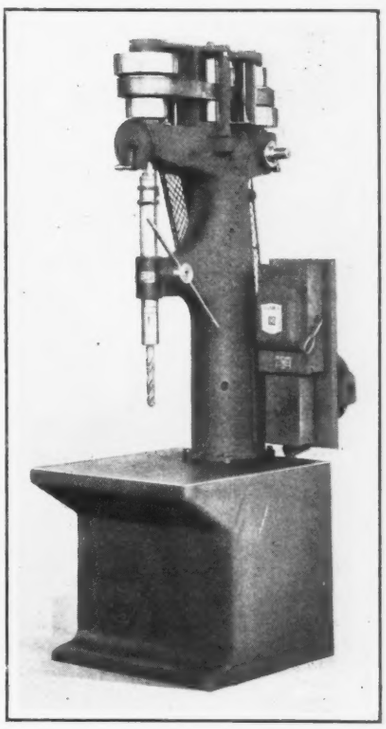
Hisey Buffing Machine with Two Independent Motor-driven Spindles

"FOOTBURT SIPP" SENSITIVE DRILLING MACHINE

A No. 3 sensitive drilling machine having a capacity for drilling 1 1/4-inch holes in cast iron and 3/4-inch holes in steel is being introduced to the trade by the Foote-Burt Co., Cleveland, Ohio. This machine embodies many of the features of the smaller-capacity "Footburt Sipp" sensitive drilling machines, including the quick-change speed arrangement, simple drive, and automatic swinging idlers.

The machine is intended for production work, being designed for setting up for one particular job, although it is possible to use various types of jigs so that the machine can be employed for other jobs should it be found necessary. Owing to the length of spindle travel, it has been possible to eliminate the usual spindle bracket with vertical adjustment and the adjustable table generally provided on drilling machines of this capacity. The maximum distance from the spindle nose to the top of the table can be made to suit requirements. It is possible to equip the machine with an automatic power feed similar to that provided on the BW and BX sensitive drilling machines built by this concern.

One of the important features of the machine is the cabinet base which is so constructed that two or more machines can be bolted together to form a gang machine having a distance of 15 inches between spindle



"Footburt Sipp" Sensitive Drilling Machine

centers. Additional units can be added to the first machine as production increases. The right-hand end of the pulley shaft is arranged for coupling to the left-hand end of the drive shaft of the next unit, so that a number of units can be driven as one machine.

Either a motor or belt drive can be provided. When the machine is belt-driven, the tight and loose pulleys are mounted in the same place as the single pulley of the motor-driven equipment. Power is transmitted from the pulley shaft through a set of spiral-bevel gears to the rear vertical cone pulley, and then through an endless belt to the front cone pulley. The latter is mounted directly on the spindle. Both cone pulleys are solid and act as flywheels to prevent the spindle from stalling when the drill enters the work.

The pulleys are balanced and do not cause irregularity in the drilling, even at high speeds. The swinging idler pulley automatically takes up belt slack as it occurs. It also tends to wrap the belt around the driving cone, insuring maximum driving power. Three speeds are obtainable by operating the crank-handle located at the front of the machine which shifts the belt to the various steps of the pulleys. Roller bearings are furnished throughout the machine. The spiral gears and the bearings in the gear-box run in a bath of oil, while all other bearings are lubricated by the "Alemite" system.

PRATT & WHITNEY UNIVERSAL DIE-SINKER

Both cherrying and straight die-sinking operations can be performed on a No. 3A universal die-sinker recently developed by the Pratt & Whitney Co., Hartford, Conn., without any changes of set-up or any special attachments. The principal feature of the machine is a patented oscillating head by means of which an ordinary die-sinking cutter can be moved through a circular path, so that both roughing and finishing cherrying operations can be performed. A double binder provides for locking the entire oscillating head solidly to the column when the machine is to be used for ordinary die-sinking cuts in which the table elevating and transverse movements are employed.

The machine is fundamentally similar to the regular Pratt & Whitney die-sinkers in that it is of the vertical type and has a knee supported by an elevating screw and sliding on vertical ways on the column. This knee carries a table which

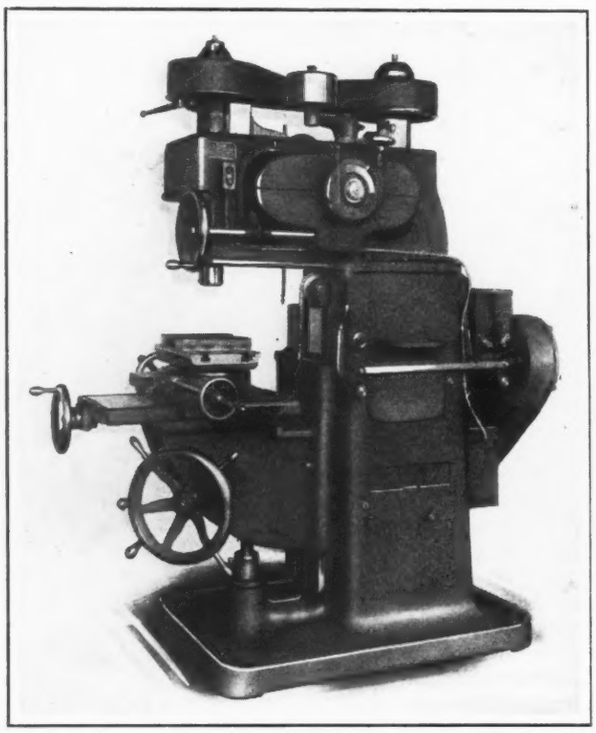


Fig. 1. Pratt & Whitney Universal Die-sinker with Oscillating Head

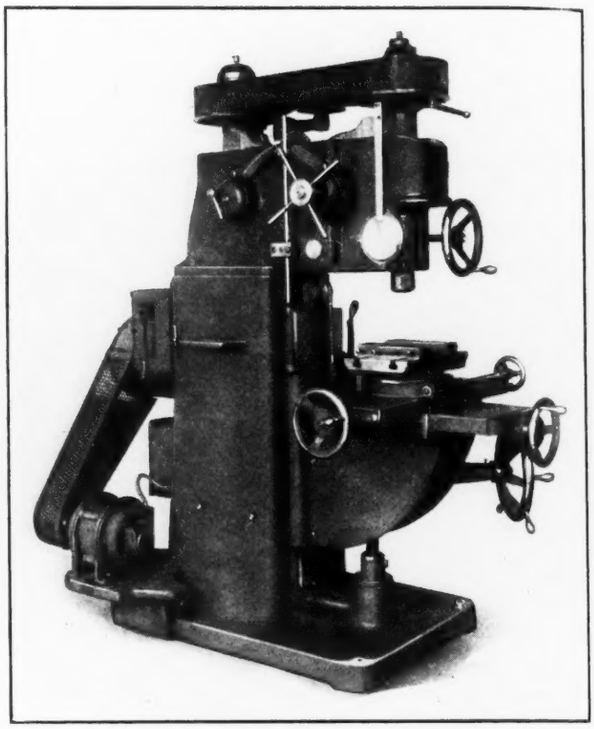


Fig. 2. Left-hand Side of the Universal Die-sinker

travels in both directions. The column is made in two pieces, and the knee is counterweighted to permit easy adjustments.

The oscillating head and its control apparatus and drive are contained in the upper part of the column, as well as the spindle mechanism, the two inside surfaces of the column being accurately scraped. The oscillating frame itself is balanced by a counterweight, and driven through two large adjustable-throw eccentrics. The diameter of the circular path of the tool can be adjusted from 0 to 6 inches by means of a mechanism inside each eccentric, which is controlled through a handwheel. A dial on the left-hand side of the column, which may be seen in Fig. 2, shows the exact position of the cutter during a cherrying operation. This dial is graduated through 180 degrees, and is inscribed with six circles which represent six even inches of radius adjustment of the eccentric sleeves. The plate is held in position by spring tension, but it may be revolved to desired settings by means of two finger spot holes. The long finger or pointer attached to the oscillating frame, which is graduated to give subdivisions of the six even inch circles on the dial, extends downward to the dial. The dial is stationary, whereas the pointer moves with the oscillating frame, and so the relative position of the pointer on the dial always represents the actual position of the tool point in the work.

The oscillating head is moved entirely by hand, through the handwheel on the front of the head. The drive to the head is through a single pulley and gear-box, and then through the pulleys at the top of the head and a set of floating bevel gears. Thus the full power of the machine is available at the spindle. A three-horsepower constant-speed motor furnishes the power. The spindle is hardened and ground at the lower end, and is fitted with lapped thrust washers. The lower bearing is conical, while the upper bearing is cylindrical, adjustments for wear being made in the lower bearing. The spindle is fitted with a spring collet that is operated by means of a quick opening and closing device.

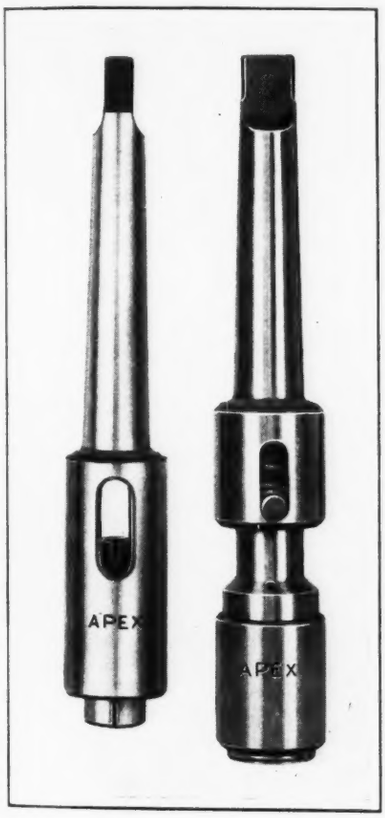
This machine will perform many types of cherrying cuts that are impossible on previous styles of the machine. For instance, by combining the rotary table feed and the oscillating cutter movement, it is possible to sink a spherical cut in the surface of a die and finish it ready for the polishing operation, all with the same cutter and without the use of an attachment. A quarter-cylindrical cut can be taken by feeding the cutter through an arc of 90 degrees. Second cherrying cuts can be taken below the surface of the die, the only limit being the length of tool which can be used

successfully without springing. By using the upper half of the oscillating head path, an inverted cherrying cut can be made either at or below the die surface.

Six spindle speeds ranging from 70 to 900 revolutions per minute are available. The maximum vertical height between the working surface of the table and the spindle nose is 23 inches, and represents the limit of work which may be accommodated. The machine occupies a floor space of 70 by 95 inches, is 93 inches high, and weighs approximately 7000 pounds, with regular equipment.

APEX TAP AND DRILL CHUCKS

A vertical-float chuck designed for use in multiple tapping operations has been added to the line of chucks manufactured by the Apex Machine Co., 300 Davis Ave., Dayton, Ohio. This chuck, or holder, is shown at the right in the accompanying illustration. It has a vertical float of 1/2 inch, and obviates tap breakage when using taps of the same or different leads. The collets that hold the taps are of the standard type used in Apex safety-friction tapholders and positive-drive drilling and tapping chucks. The new tapping chuck is made in two sizes, having a capacity for 3/8- and 3/4-inch standard taps, respectively. It is furnished with a friction drive for bottom-hole tapping.

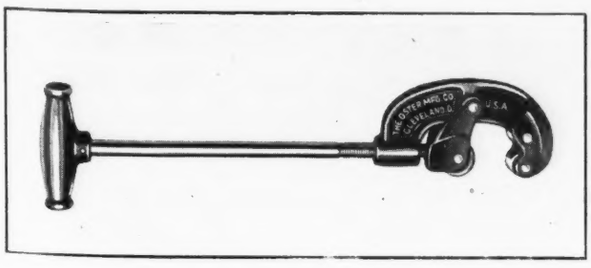


Apex Tap and Drill Chucks

A line of close-center drill chucks has also been brought out by the same company for holding straight-shank drills at center distances of less than 1 1/8 inches. One of these chucks is shown at the left in the illustration. Drills are held in these chucks or holders by means of a taper bushing. The chucks are made in four sizes, having an outside diameter of 1/2, 5/8, 3/4, and 1 inch, respectively. Straight-shank drills up to 5/16 inch can be held in the chucks.

OSTER PIPE CUTTER

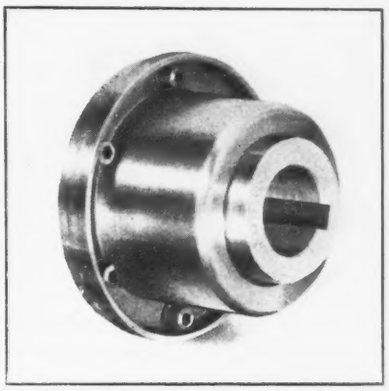
Two sizes of a Saunders roller-type pipe cutter have recently been placed on the market by the Oster Mfg. Co., Cleveland, Ohio. One of these sizes is suitable for cutting from 1/8- to 1-inch pipe, and the other for cutting from 1/2- to 2-inch pipe. The device was designed primarily to be turned by means of a mechanical drive, such as the Oster power-driven pipe threader, but it is also applicable for hand use. Rollers and cutter wheels can be changed easily.



Oster Pipe Cutter intended for Power or Hand Operation

FALK FLEXIBLE COUPLING

A flexible coupling of new design is being placed on the market by the Falk Corporation, Milwaukee, Wis., to insure direct-connected equipment against the hazards of ordinary shaft misalignment. The coupling has a high torsional resilience, which safeguards the driving unit from the vibration of the driven machine. The construction of the coupling is simple, embodying a tempered steel spring which is made in segments; two flanged steel disks having slots into which the spring fits; and a steel shell. The steel shell protects the other parts from dirt, acts as a simple fastener for the spring, and serves as a container for lubricant. All parts are made of steel, and are positively lubricated.

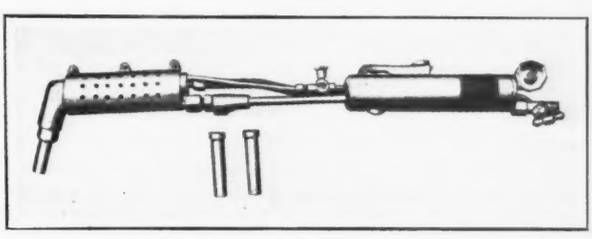


Falk Flexible Coupling of New Design

The construction of the coupling provides for the disconnection of coupled shafts without disturbing either the machine or the driving unit. Alignment of the coupling is easily obtained, requiring the use of only a short straightedge and an ordinary set of feelers. Standard sizes of the coupling are manufactured for transmitting from 1/3 to 20,000 horsepower at 100 revolutions per minute.

MILBURN OXY-ILLUMINATING GAS TORCH

A cutting torch designed for use with illuminating and by-product gases is the latest development of the Alexander Milburn Co., 1416-28 W. Baltimore St., Baltimore, Md. An important feature of this torch is the superheater which heats and expands the cutting oxygen and the preheating gases, raising the temperature of the cutting oxygen to approximately 100 degrees C. prior to combustion. This increases the temperature of the gases at the torch tip, increases the rate of flame propagation in the burning mixture, and reduces the oxygen consumption from 25 per cent upward. A Bunsen burner contained within the torch burns illuminating gas which heats the cutting oxygen as it passes through a series of copper coils.



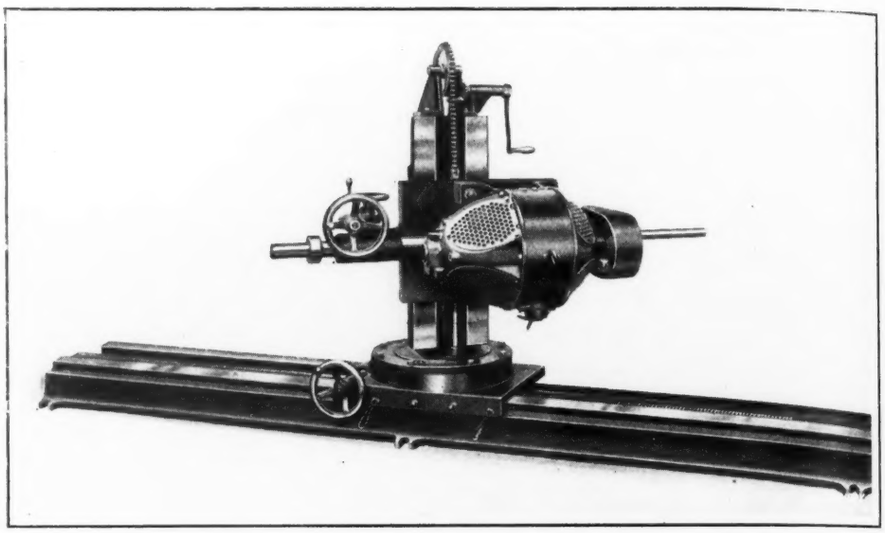
Milburn Cutting Torch used with Illuminating and By-product Gases

The heated and expanded oxygen, in conjunction with the illuminating gas, is said to give better penetration into the metal, a narrow kerf, sharp clean edges, and fast smooth cutting, with a notable absence of metallic slag on the under side of the cut. The surfaces cut do not become casehard-

ened. The torch operates on city or natural gas. It is constructed of bronze forgings and specially drawn tubing. The high-pressure cutting oxygen is controlled by means of a thumb-valve which remains fixed in either the open or closed position. The torch is 21 inches long, and is supplied with a complete range of tips for light, medium, and heavy cutting.

HOEFER PORTABLE DRILLING MACHINE

The size and weight of the crankshafts used in large Diesel engines make it practically impossible to move the shafts under an ordinary drilling machine for drilling the oil-holes through the crank throws. To meet this drilling problem, the Hoefer Mfg. Co., Freeport, Ill., has developed the portable horizontal machine here illustrated. The bed of this machine is long enough to permit horizontal travel of the column along the full length of the crankshaft, with one setting of the bed. For an operation, the machine is bolted to the floor.



Hoefer Portable Machine designed for drilling Long Work

The column is easily and quickly moved to any position desired, by simply turning the handwheel seen on the saddle, and then the saddle can be instantly locked in position. The column is fastened to the saddle by means of a swivel bearing, which permits of positioning the column and clamping it at any angle to suit the oil-hole to be drilled. A counterbalanced self-contained drill head mounted on the column is equipped with a motor which drives through pick-off gears. The gears provided give an ample range of speeds to meet the requirements of the machine. The spindle and spindle quill are of sufficient length to give a feed of 20 inches. Ball bearings are provided for the spindle.

The crank seen on the upper end of the column permits 12 inches of up-and-down adjustment of the head. By providing longer beds, this machine can be adapted to shafts of any length.

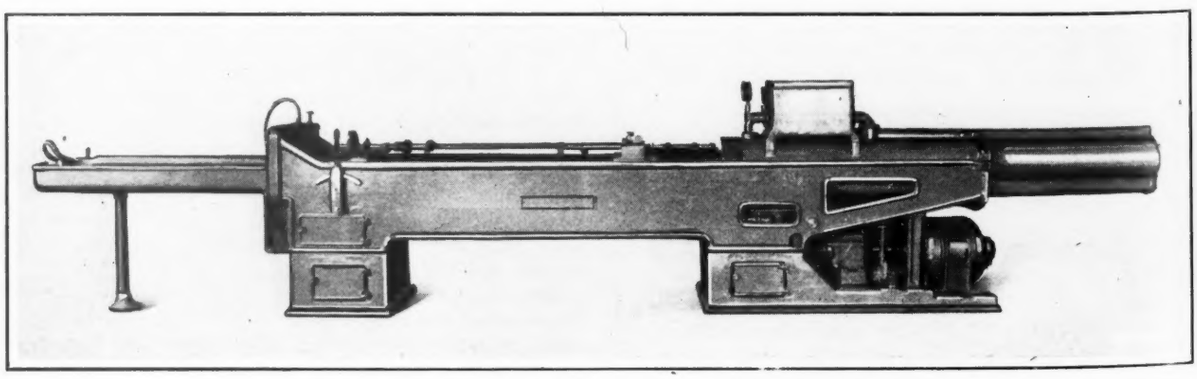
J. N. LAPOINTE HYDRAULIC BROACHING MACHINE

A special hydraulic machine designed primarily for broaching bronze and nickel-silver tube castings 5 feet long was recently built by the J. N. Lapointe Co., New London, Conn. With the exception of the unusual length of stroke and the capacity, the machine is similar to that described in May MACHINERY. From the accompanying illustration, it will be seen that the special machine is equipped with an auxiliary sliding head for supporting the draw shank. The maximum stroke of the machine is 102 inches; the pulling capacity, 73,000 pounds with a pressure of 1000 pounds per square inch; the diameter of the cylinder, 10 1/2 inches; the maximum cutting speed, 15 feet per minute; and the maximum return speed, 60 feet per minute.

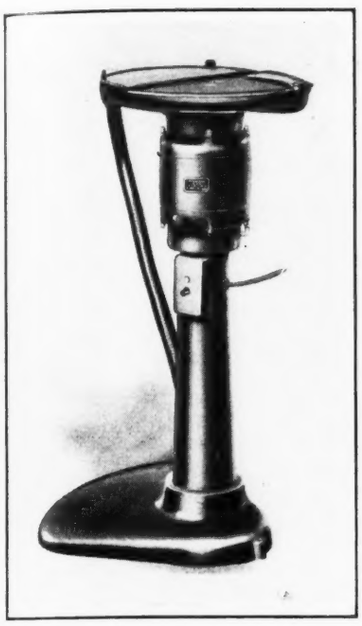
SYRACUSE HORIZONTAL DISK GRINDER

A 15-inch horizontal disk grinder of the design here illustrated is being placed on the market by the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y. This machine was originally developed for removing burrs from small metal parts and, at the same time, producing flat surfaces on these parts. The operator sits in a chair beside the machine, rests his arm on the guard plate and, using his elbow as a pivot, moves his hand through a small arc, at one end of which there is a box containing the parts to be burred. The revolving disk is at the opposite end of the arc. The production in this operation is only limited by the speed of the operator, as the disk quickly removes the burr and the dust is carried away by a patented dust remover. The machine is believed to be the only motor-driven horizontal disk grinder of its size, and may be used for burring innumerable small parts after milling, pressing, stamping, or screw machine operations.

The vacuum dust remover consists merely of fins cast on the back of the metal disk and proper outlets and a metal hose for carrying the dust away. Rotation of the disk produces a vacuum in the outlets, which sucks in the dust and blows it through the exhaust hose. For work requiring more than one-half of the disk, the guard plate may be quickly removed by taking out two thumb-screws, and the auxiliary guard is then swung to one side or removed altogether. Being driven from a lamp socket or a power line, the grinder can be easily moved to any part of the shop. It need not be



J. N. Lapointe Hydraulic Broaching Machine of Special Design



Syracuse Motor-driven Disk Grinder

bolted to the floor, but provision is made for fastening it in this way. The iron disk is carefully balanced after machining, and is supported by a thrust bearing built into the 1/2-horsepower General Electric motor, of special design, employed to drive the disk. The motor is controlled through a two-pole push-button switch located in the pedestal. All wiring, with the exception of the rubber-covered conductor cable, is concealed. The disk is 40 inches above the floor. The motor runs at a speed of 1725 revolutions per minute.

* * *

NOVEL METHOD OF DEMONSTRATING TOOLS

The accompanying illustration shows a novel method developed by E. Gairing of the Gairing Tool Co., Detroit, Mich., for demonstrating tools made by the company. As shown, the tools revolve in relation to pieces of work shown in section, so that the complete tool is visible to the observer. The tools are driven from an electric motor geared to a longitudinal shaft carrying worms which mesh with worm-wheels on vertical shafts, through which the respective tools are driven. The tools are held in a hollow center at the bottom and by a regular center at the top, the latter being carried by an arm projecting from a vertical support rod.

In order that the tools may be demonstrated anywhere, irrespective of what current may be available, both alternating- and direct-current motors are carried in the base, and either can be connected with the current supply available. As the tools are driven by a friction device only, the operator can stop them by simply holding them with his hand, and any point relating to the cutting edges or the construction of the tool may be clearly shown with one tool held still while all the others continue to revolve. In the illustration, seven tools are demonstrated, a core drill and reamer, a countersink, a back spot facing cutter, a core drill, a counterbore, a spot facer, and another type of counterbore.

A Novel Method of demonstrating Tools in Action

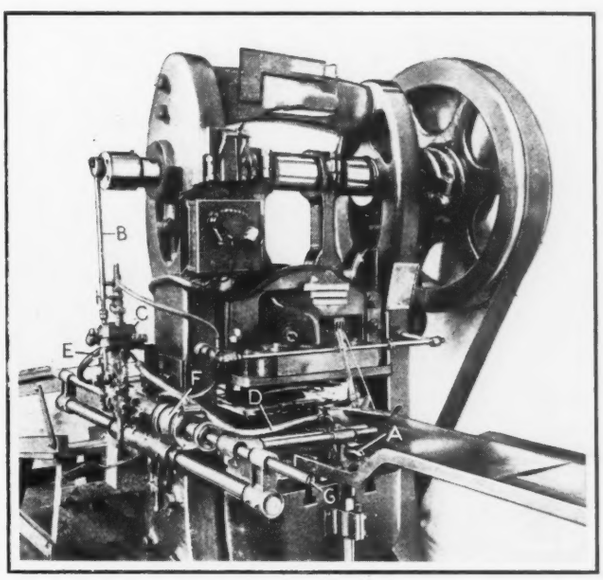
OBITUARIES

HOWARD L. FRANKLIN, president of the Franklin Die-Casting Corporation, Syracuse, N. Y., died suddenly on October 16, aged sixty-nine years. He was stricken ill while playing golf on the Bellevue Country Club course. Mr. Franklin had been president of the Franklin Die-Casting Corporation since November, 1919, when it was separated from the H. H. Franklin Mfg. Co. and incorporated as a separate unit. He had been actively connected with the die-casting industry since 1898, when he joined his brother Herbert H. Franklin, president of the H. H. Franklin Mfg. Co., in the development of this new industry. Mr. Franklin was a director of the H. H. Franklin Mfg. Co. and the Liberty National Bank of Syracuse.

T. JAMES FERNLEY, secretary-treasurer of the National Hardware Association, died at his home in Germantown, Philadelphia, October 18, at the age of sixty-five. He was well known throughout the country for more than thirty years as secretary of various associations in the jobbing and retail hardware trades.

FEEDING PRESSES WITH PNEUMATIC EQUIPMENT

Pneumatic devices are used extensively in the shops of the General Electric Co., Schenectady, N. Y., for automatically feeding steel sheets through power presses. A small press so equipped is shown in the accompanying illustration. The feeding is accomplished by means of fingers *A*, which are located both at the front and back of the machine and sometimes on both sides of the sheets as well. These fingers are intermittently closed to grip a sheet and, at the same time, moved horizontally to carry the sheet through the dies.

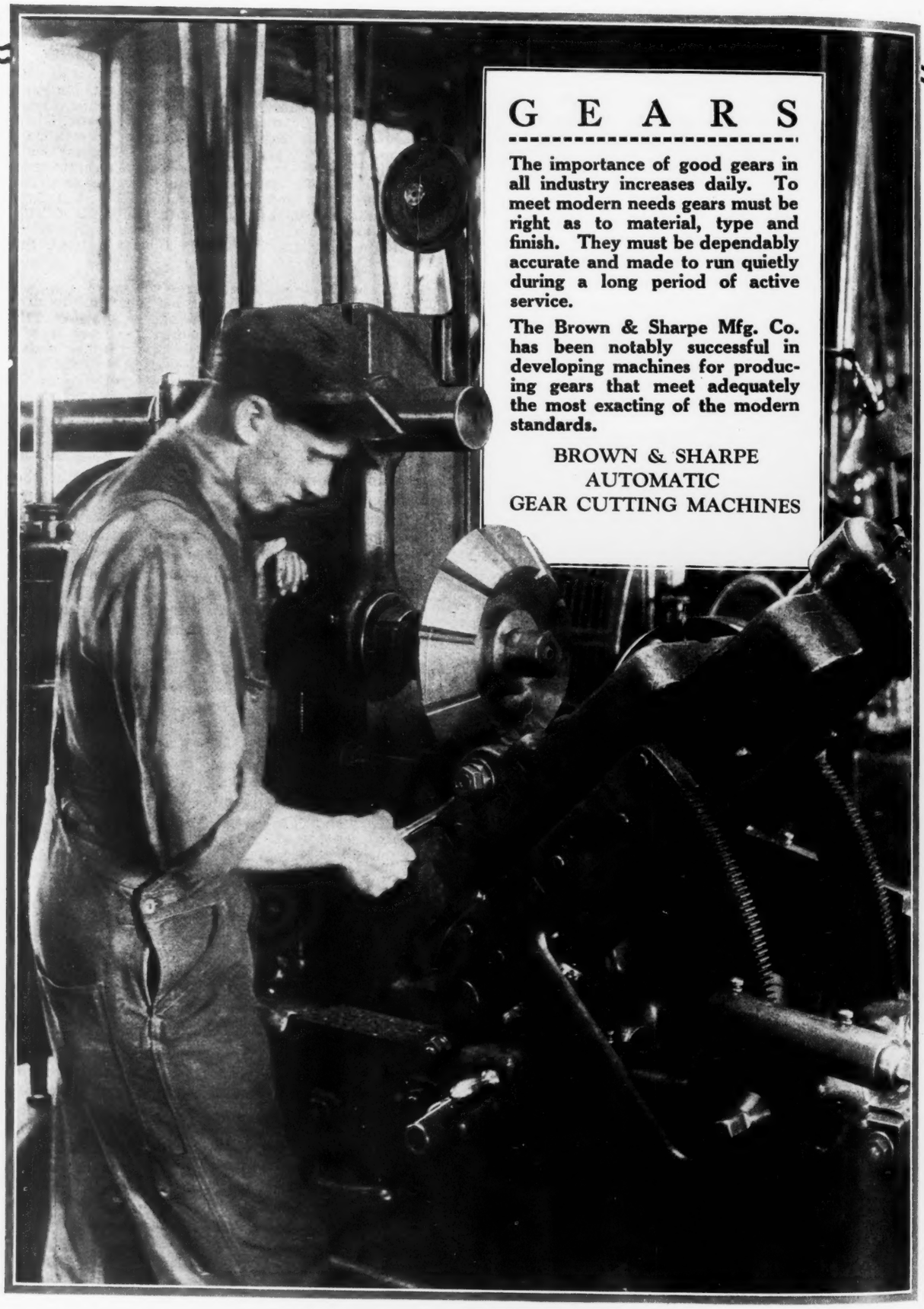


Power Press equipped with Pneumatic Feeding Device

With each stroke of the press, rod *B* operates valve *C* to admit air through hoses *D* and *E* into valves contained in the holders of the gripping fingers. Air is simultaneously admitted into cylinder *F* to slide rod *G* back and forth. The rods on which the holder of fingers *A* is mounted, are, in turn, fastened to rod *G*, and so the fingers are moved horizontally with rod *G*. It will be understood that the air passed through hose *E* actuates the fingers at the rear of the machine. Compressed air having a pressure of about 80 pounds per square inch is used for operating the mechanism. Fingers *A* are open when the punch enters the die.

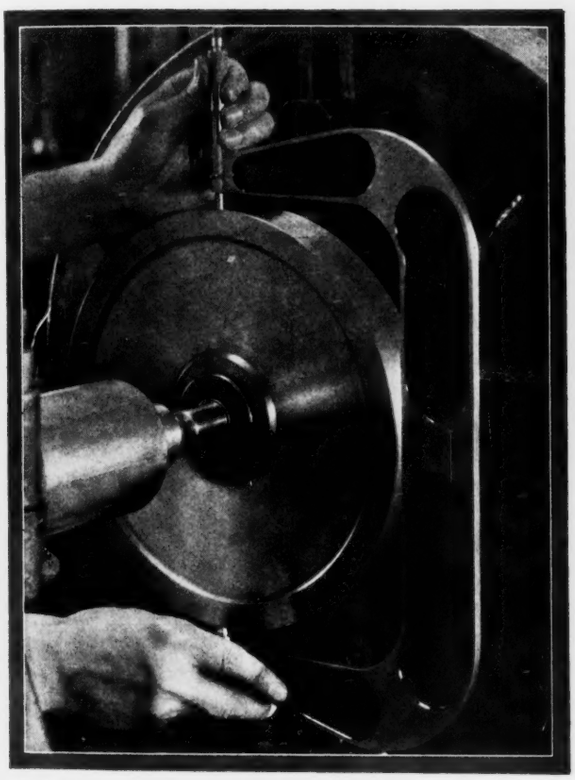
* * *

Eighty thousand new freight cars were installed in service by the railroads during the first nine months of this year, with some 40,000 additional cars on order on October 1.

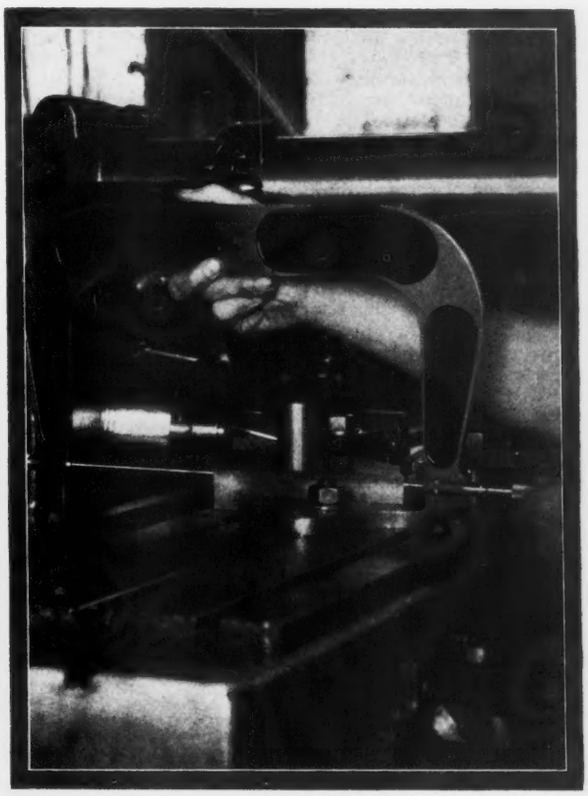

GEARS
The importance of good gears in all industry increases daily. To meet modern needs gears must be right as to material, type and finish. They must be dependably accurate and made to run quietly during a long period of active service.
The Brown & Sharpe Mfg. Co. has been notably successful in developing machines for producing gears that meet adequately the most exacting of the modern standards.
BROWN & SHARPE
AUTOMATIC
GEAR CUTTING MACHINES

The machine shown in use above is a No. 13 Heavy Automatic Gear Cutting Machine for spur and bevel gears. Catalog No. 138 lists four sizes for spur gears and two sizes for spur and bevel gears. Send for a copy.

When it's a big job and must be accurate— use a Brown & Sharpe



The No. 55 micrometer is similar in design to the No. 57 but is smaller. It has a range of 2 in. to 6 in. by thousandths. When you need a large "mike" get a dependable, accurate Brown & Sharpe.



THE Brown & Sharpe Line includes a variety of large micrometers sufficient to meet all industrial needs.

For the shop where the need for a large micrometer is occasional, but nevertheless imperative, we recommend the Brown & Sharpe No. 57, shown here in use.

It measures from 6 in. to 12 in. by thousandths of an inch. This range of measurement is obtained with the interchangeable anvils furnished. These anvils are easily and quickly changed and held accurately in place.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

The No. 30 Small Tool Catalog is a handbook of modern small tools and cutters. It is bigger, describes new and improved tools, contains helpful hints and tables and shows tools in use. You should have a copy for reference purposes. If your dealer cannot furnish a copy write us direct.

PERSONALS

GEORGE BOEHNER has joined the sales organization of the American Hammered Piston Ring Co., Baltimore, Md. His territory will comprise Minnesota and North and South Dakota. Mr. Boehner's headquarters will be at Minneapolis.

GORDON H. MCCRAE, London, England, vice-president of the Independent Pneumatic Tool Co., is making a business visit at the home office in Chicago and factory at Aurora, Ill. Mr. McCrae is in charge of the London office of the company.

GILBERT H. UNRUH, representative of the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., will be permanently located in Baltimore, Md., for the greater convenience of the customers in the Maryland district. Mr. Unruh's address at present is 618 Regester Ave., Stoneleigh, Baltimore Co., Md. (Govans P. O.).

C. W. SPROULL, of Allen, Sproull & Allen, Fort Worth, Tex., manufacturers' representatives, recently visited Bridgeport to complete arrangements to represent the Bridgeport Brass Co. in the Southwest for the sale of the Bridgeport line of plumbing goods, "Plumrite" brass pipe and fittings, and Bridgeport-Keating flush valves.

VERNON C. WARD has been made manager of the new Junior beam department of the Jones & Laughlin Steel Corporation, Pittsburg, Pa. For the last seventeen years Mr. Ward has been contracting engineer with the American Bridge Co. in Chicago, and has had a wide experience in the marketing of structural material.

J. R. BRANDT has joined the Cleveland office of the Bridgeport Brass Co., located at 2017 Superior Viaduct, as raw material salesman in the Pittsburg territory and parts of Ohio. Mr. Brandt was previously associated with the United States Copper Products Corporation, the Rome Hollow Wire & Tube Co., and the Hennig Nickel Rolling Mills.

J. M. ALLEN has recently joined the factory organization of the Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill., as manager of production. Mr. Allen was manager of production of the Mosler Safe Co., Hamilton, Ohio, for five years, and manager of production and traffic for the Goldsmith Metal Lath Co., of Cincinnati, Ohio, for about a year.

EDWARD H. CHENEY has been appointed sales manager of the Wagner Electric Corporation, St. Louis, Mo., succeeding THOMAS T. RICHARDS. Mr. Cheney has been with the Wagner Corporation since 1905, when he became Chicago office manager. In 1909 he was promoted to the position of Chicago district manager, which he has held up to his present appointment as sales manager.

HALE J. DENNY has been appointed salesman in the Chicago territory, for the line of tubular plumbing supplies, flush valves, and brass pipe made by the Bridgeport Brass Co., Bridgeport, Conn. Mr. Denny, who will work under the direction of R. M. Hubler, Chicago district manager of the company, has been identified with the plumbing specialty industry for about five years in the vicinity of Chicago.

W. J. ULRICH has been appointed district sales manager of the coated abrasive sales division of the Carborundum Co. in the Detroit territory. Mr. Ulrich will have complete charge of the sales of carborundum brand garnet paper and cloth, carborundum paper and cloth, aloxite paper and cloth, and carborundum brand waterproof finishing papers in this district. He was formerly district sales manager for the Manning Abrasive Co., in charge of the Detroit branch.

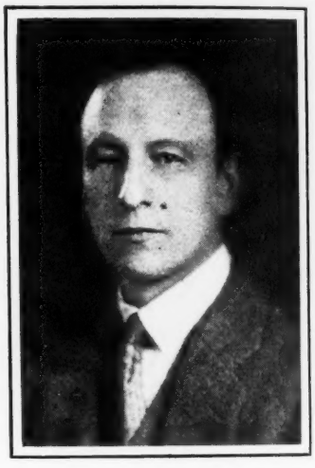
R. C. BROWER has been appointed general manager of the Timken Roller Bearing Service & Sales Co. Mr. Brower will make his headquarters in Canton, Ohio, at the main plant of the Timken Roller Bearing Co., but will devote a great deal of his time to maintaining contact in the field. For the last four years he has been connected with the automotive and industrial machinery sales divisions of the company. Prior to that he was, for many years, eastern and central district manager of the Bearing Service Co., which was absorbed when the Timken Roller Bearing Service & Sales Co. was organized.

W. B. FLANDERS, formerly engineer with the large turbine division of the engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed assistant manager of engineering. R. C. ALLEN, formerly assistant to the chief engineer, has been appointed manager of large turbine engineering. J. A. MACMURCHY, formerly engineer with the small turbine division of the engineering department, has been appointed manager of small turbine engineering. D. W. R. MORGAN, formerly engineer with the condenser division, has been appointed manager of condenser and internal combustion engineering.

YALE D. HILLS has been appointed branch manager of the Seattle branch of the Timken Roller Bearing Service & Sales Co. Mr. Hills was formerly branch manager of the Portland branch. R. H. CROSS, who held the position of Seattle branch manager prior to Mr. Hills, has been made assistant to G. C. McMullen, district manager of sales, Industrial Division. Mr. Cross will continue to maintain offices at Seattle. E. N. BEISHEIM, formerly of the Bock Bearing Co., Toledo, Ohio, has been appointed assistant to the general manager of the Timken Roller Bearing Service & Sales Co., Canton, Ohio. S. C. PARTRIDGE has been placed in charge of the Buffalo office, Industrial Division, of the Timken Roller Bearing Co. Mr. Partridge takes the place of LEE WARRENDER, who resigned to enter another field of work.

COLONEL LEONARD S. HORNER has been elected president of the Niles-Bement-Pond Co., 111 Broadway, New York City, to fill the vacancy made by the resignation of JAMES K. CULLEN. Mr. Cullen will devote his entire time in the future to his activities as president and general manager of the Niles Tool Works Co., Hamilton, Ohio. Colonel Horner recently resigned as vice-president and manager of sales of the Acme Wire Co., New Haven, Conn., of which company he continues as a director. He is a graduate in electrical engineering of Lehigh University. After his graduation, he served with the American Telephone & Telegraph Co. as construction engineer, and was later electrical engineer and sales manager for the Crocker-Wheeler Co. He left the Crocker-Wheeler Co. to join the Acme Wire Co., but still serves as a director of both companies.

GERALD FIRTH has been elected general manager of the Firth-Sterling Steel Co., McKeesport, Pa., after having filled the position of works manager for eight years previously. Mr. Firth was born in Sheffield, England, in 1886. His great grandfather was Thomas Firth, one of the original members of the firm of Thos. Firth & Sons, Sheffield, England, which started business in 1842. His grandfather, John Firth, started the present business in the United States in 1855, and his father, Lewis J. Firth, has been connected with the Sheffield company and the American business for over fifty years.



Gerald Firth, General Manager of the Firth-Sterling Steel Co.

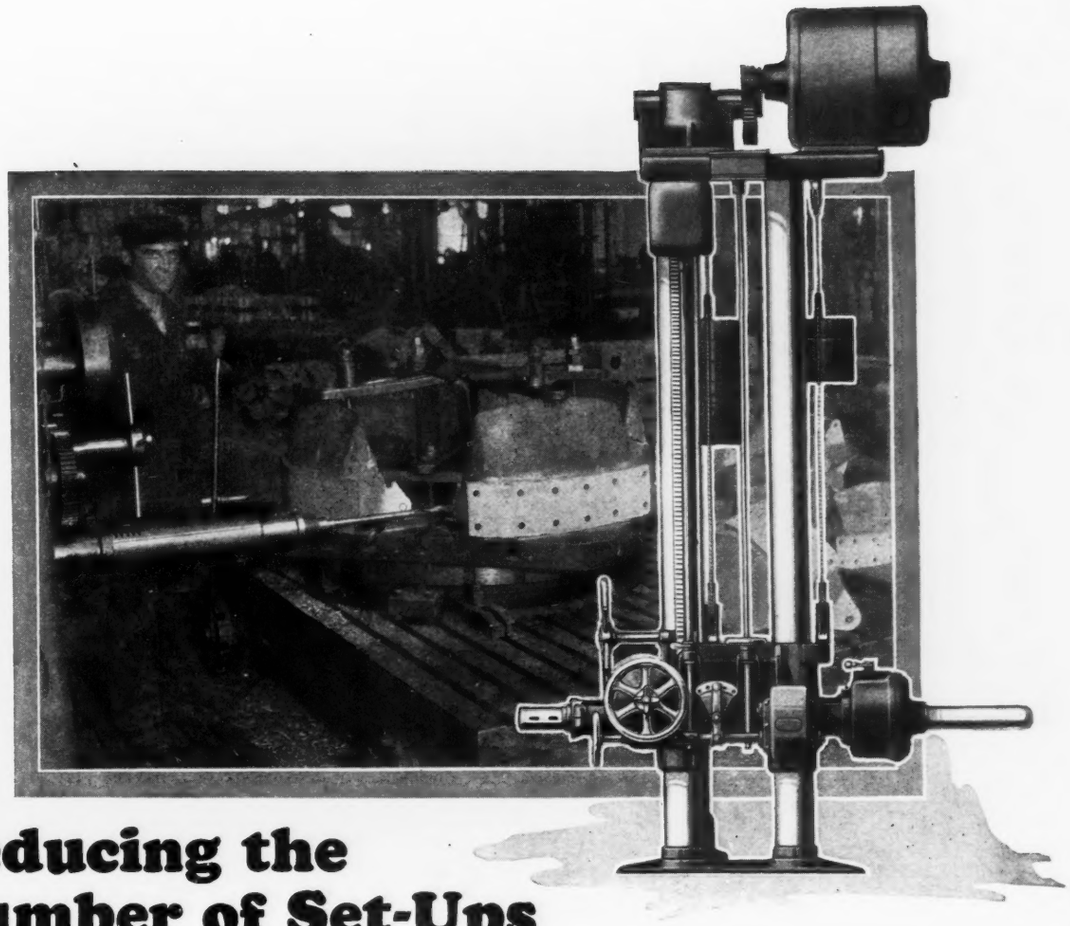
Gerald Firth was educated at Uppingham School and later at Trinity College, Cambridge, England. In 1910 he came to the Firth-Sterling Steel Co., McKeesport, to investigate the requirements of the business in the United States before taking up the study of tool and die steels at the Sheffield Works of Thos. Firth & Sons, Ltd. Later he worked at the bench in Sheffield for nearly two years as an inspector in the tool steel warehouse.

Early in 1914 he returned to McKeesport, but in August of the same year, when the war broke out, he went back to England and obtained a commission as lieutenant in the field artillery. After service first in France, and later in the manufacture of ammunition in Great Britain and the United States, he again returned to France in 1916. In 1917 he was severely wounded in the knee by fragments of a shell, and amputation became necessary. In 1918 he was able to return to the works of the Firth-Sterling Steel Co., McKeesport, and was made works manager of the company, which position he has held until his appointment as general manager this year. His experience in the manufacture of tool and die steels and what is known as stainless steel—a material developed at the Norfolk Works of Thos. Firth & Sons, Ltd.—has proved of great value in his work in America.

* * *

MARKET FOR MACHINE TOOLS IN CZECHO-SLOVAKIA

Commercial Attaché James F. Hodgson reports from Prague to the Department of Commerce that the demand for American machine tools in Czecho-slovakia continues to be quiet, owing to the period of business stagnation through which the country is passing. Two of the important machinery industries in Czecho-slovakia—the building of sugar mill machinery, and the making of agricultural machinery and implements—are both very much depressed. The automobile factories, which are ordinarily large buyers of machine tools, have not been in the market for equipment during recent months, as they made heavy purchases the latter part of last year, covering all present requirements. Germany continues to be the strongest competitor of the United States in this market in the sale of machine tools.



Reducing the Number of Set-Ups

Drilling and Boring of Large, Bulky Pieces Handled in Much Less Time

ALL pieces, large and small, are quickly and easily handled by the Ryerson Horizontal. The movable worktable and great vertical range of the spindle permit work over an extremely large area without resetting the job. With a simple rotary table four sides of a casting can be worked from the one setting; with a universal table accessible sides in any plane can be machined.

The use of movable worktables in conjunction with this horizontal type of drill saves the time often lost between jobs. Another job can be set while one is in operation so that the drill is kept continually busy.

Other features of the Ryerson Horizontal that are helping reduce the time on difficult drilling and boring jobs are described in Bulletin 4051. Write for a copy.

JOSEPH T. RYERSON & SON INC.

Established 1842

PLANTS: CHICAGO ST. LOUIS CINCINNATI DETROIT BUFFALO MILWAUKEE BOSTON NEW YORK
BRANCH OFFICES: Pittsburgh Cleveland Minneapolis Denver Tulsa Louisville Houston Los Angeles San Francisco

RYERSON MACHINERY

LATHES	PUNCHES	SMALL TOOLS	HORIZONTAL DRILLS	SERPENTINE SHEARS
DRILLS	SHEARS	FRICTION SAWS	POWER HAMMERS	HYDRAULIC MACHINERY
PLANERS	MOTORS	BEVEL SHEARS	BENDING ROLLS	SPRING SHOP EQUIPMENT
SHAPERS	BULLDOZERS	MILLING MACHINES	PNEUMATIC MACHINERY	FLUE SHOP EQUIPMENT

TRADE NOTES

ARTER GRINDING MACHINE CO. has just completed and is now occupying a new factory at 15 Sagamore Road, Worcester, Mass.

E. P. PIERCE CO., 4903 Harlem Ave., Cleveland, Ohio, has recently made an addition to its plant of about 4000 square feet, which doubles the former floor space.

AIR REDUCTION SALES CO., INC., 342 Madison Ave., New York City, has acquired all the assets of the Dayton Oxygen and Hydrogen Products Co., of Dayton, Ohio. The plant went into operation under Air Reduction management on October 15.

PITTSBURG GEAR & MACHINE CO., 2700 Smallman St., Pittsburg, Pa., has appointed Mitchell & Dale, 43 S. Gay St., Baltimore, Md., agent for the company in that territory. Frank J. Bowers, Youngstown, Ohio, has also been appointed agent for the company.

I. H. JOHNSON, JR., CO., INC., builder of machine tools, 1422-1438 Callowhill St., Philadelphia, Pa., announces that the firm is retiring from business and is disposing of both equipment and property. At the present time no new orders are being taken, and some of the stock parts and equipment have already been disposed of.

GISHOLT MACHINE CO., Madison, Wis., has recently opened its own office at 8-219 General Motors Bldg., Detroit, Mich., under the charge of U. S. James who has been the company's special factory representative in the Detroit district for some years. Mr. James will be assisted by F. M. Long, Arnold S. Beckman, E. F. Addleton, and W. S. Salmon.

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill., has opened a new branch office in Utica, N. Y., at 107 Foster Building, 131 Genesee St. This office will be devoted to the sale of Link Belt silent chain and roller chain. F. P. Hermann, Jr., will be in charge. The company also announces that its Boston office, formerly at 49 Federal St., will be located at 1103-1104 Statler Bldg., after November 1.

DAYTON-DUNBAR, INC., 149 Broadway, New York City, has been established to deal in machine tools and high-grade production equipment. P. K. Dayton is president and M. G. Dunbar, for many years the New York and New England representative of the Landis Tool Co., is treasurer. The firm is the exclusive agent of the Reed-Prentice Corporation, the Cincinnati Engineering Tool Co., the Stockbridge Machine Co., and the Wade Tool Co., and is negotiating for further lines.

ROBERT J. ANDERSON, INC., has been organized to operate as a commercial testing laboratory, specializing in metals and alloys. The new laboratory, which is situated at 2416-38 Beekman St., Cincinnati, Ohio, is fully equipped for chemical analysis, mechanical testing, metallography, heat-treatment, and radiography. It will be under the direction of Dr. Robert J. Anderson. The officers of the company are Dr. Robert J. Anderson, president; H. J. Hater, treasurer; and R. T. Mesker, secretary.

JOSEPH HYMAN & SONS, Philadelphia, Pa., dealers in new and rebuilt power presses, inform us that there was an error in the news item on page 160-A of October MACHINERY. It was mentioned that the presses carried in stock range from 6000 to 250,000 pounds, whereas it should have been stated that the firm also carries in stock hundreds of presses of less than 6000 pounds each. The new building into which the firm has recently moved is a thoroughly modern construction, and provided with three overhead traveling cranes and a railroad siding running into the building.

KINITE CORPORATION, Milwaukee, Wis., manufacturer of Kinite die steel, announces the following additions to its sales force: Kenneth L. Clark, formerly of the steel division of Henry D. Disston & Sons, Philadelphia, Pa., will supervise the Kinite Corporation representation in Michigan, Illinois, Indiana, Iowa, and a portion of Missouri. The Detroit office, Room 2-233, General Motors Building, will be in charge of R. H. Herbst, formerly of the Milwaukee office. Mr. Herbst will represent the company in the state of Michigan. P. L. Getzinger, with offices at 709 First National Bank Building, Chicago, Ill., represents the company in Illinois and Indiana.

TON-TEX CORPORATION has been incorporated under the laws of the state of Michigan to manufacture a thin duck composition belt known as "Ton-Tex," for both transmission and conveying purposes. The main sales offices and stock rooms of the company are located at 345-351 W. 35th St., New York City, and the factory is in Grand Rapids, Mich. George S. Baker is vice-president and general manager of the new company. Mr. Baker was formerly publicity manager of the New York Leather Belting Co., and later founded the Olmsted-Flint Co. to manufacture leather belting. In 1915 he sold his interest in that company and became eastern manager of sales for the Rainivillk Co., Grand Rapids, Mich., manufacturer of leather belting, after which he became general sales manager of the Fabreeka Belting Co., of Boston, holding this position until last March, when he resigned to organize the Ton-Tex Corporation.

STANDARD ELECTRIC TOOL CO., formerly located at Canal and Jackson Sts., Cincinnati, Ohio, has recently been purchased by G. H. FELTES, and will be moved into a new plant located at 1938 W. 8th St., Cincinnati. New equipment is being installed and there will be one-third more floor space. The officers of the company will be G. H. Feltes, president and treasurer; John Feltes, vice-president; and R. C. Feltes, secretary. G. H. Feltes has had a wide experience in the electrical tool business. He was connected with the United States Electrical Tool Co., Cincinnati, from its formation in 1904 until he disposed of his interests in that company in 1925. During this period he filled the positions of secretary, treasurer, and sales manager. In the new shop, the Standard Electric Tool Co. will build a line of portable electric drills and grinders and floor and bench types of grinders and buffers, adding also a line of heavy-duty grinders and buffers, built in 3, 5, 7 1/2, and 10 horsepower capacities.

NORTON CO., Worcester, Mass., has made several changes in its sales organization: Hiram N. Cudworth, who has been connected with the company for more than twenty years, has retired as district manager for the Machine Division in Chicago. He retains his association with the company in a consulting capacity. Oscar E. Nordstrom, formerly district manager for the Machine Division in Cleveland, succeeds Mr. Cudworth at Chicago. M. E. Mattson, until October 1 a representative in the Chicago district, has been appointed district manager in Cleveland. C. H. Hill, who has been located in Indianapolis, will have his headquarters at the Chicago office, but will continue to call on customers in Indiana, Kentucky, and Missouri. It is also announced that George M. Bowen has resigned as a grinding wheel salesman in Detroit. He will be succeeded by Karl E. Herrick who was connected with the Norton sales organization several years ago as a grinding wheel salesman and assistant sales manager of the Refractories Division.

* * *

ELMER SPERRY TO RECEIVE JOHN FRITZ MEDAL

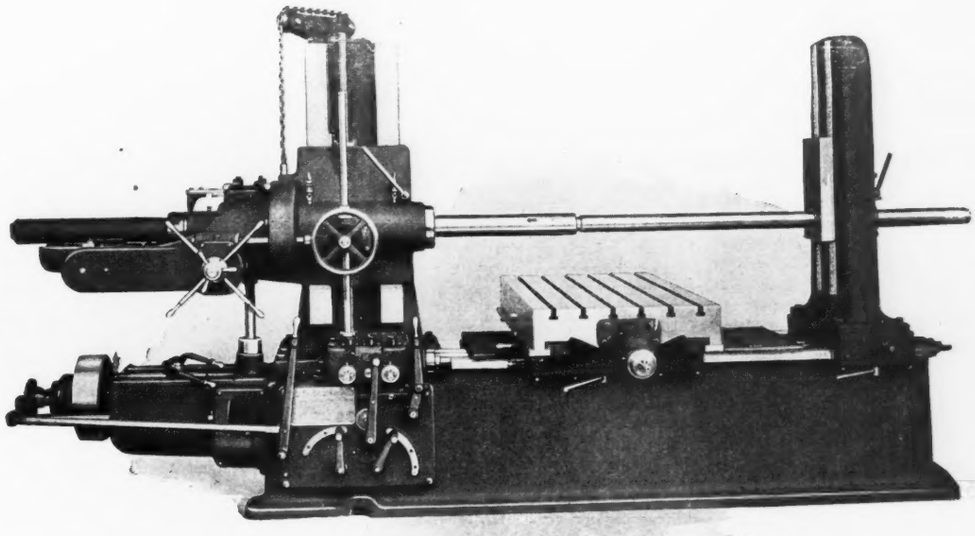
The John Fritz Gold Medal for 1927, the highest honor conferred upon an engineer by the national engineering societies, and which is awarded by the American Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers, will be presented to Elmer Ambrose Sperry of New York City for the development of the gyro-compass and the application of the gyroscope to the stabilization of ships and airplanes. The presentation of the medal will take place Tuesday evening, December 7, in the Engineering Societies auditorium, 29 W. 39th St., New York City, in connection with the annual meeting of the American Society of Mechanical Engineers.

Mr. Sperry, engineer and inventor, was born in Cortland, N. Y., in 1860. In 1879, when not yet twenty years old, he made his first successful invention and shortly afterward secured the practical adoption of an improvement on one of the first electric arc lights in America. In the following year, he founded the Sperry Electric Co., of Chicago, manufacturing arc lamps, dynamos, motors, and other electric appliances. Since that time Mr. Sperry has to his credit a long record of achievements, inventions, and developments in practically every field where electricity is used, including electrical mining machinery, electric lighting, street railway cars, electric automobiles, and batteries. About thirty years ago he turned his attention to the gyroscope, and has found important practical applications for what was once a mere scientific curiosity. Mr. Sperry's gyroscopic ship stabilizer is recognized by naval architects as a most important innovation in ship design, and his gyroscopic compass is used by all the leading maritime nations of the world. Mr. Sperry has also been active in the internal combustion field, and has developed several devices used in aerial navigation.

* * *

The following reasons have been given by J. Lawrence Laughlin, professor emeritus of political economy of the University of Chicago, for continued general activity in the industries: (1) Little or no speculation in the carrying of goods or materials for a rise, and consequent low inventories; (2) low rates of interest; (3) fair average harvests; (4) production more nearly at capacity than for some years past; (5) heavy car loadings; (6) enormous increases in bank clearings; (7) lower taxes; (8) the funding of European debts; (9) increasing economic activity and purchasing power in Europe. Some of the items listed are, perhaps, the results rather than the causes of continued prosperity, but all in all, the points made are reassuring.

"IDEALS ARE BORN OF VISION"
The vision was of a machine on which two or more holes could be bored parallel an exact distance apart.

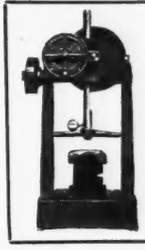


THE IDEAL is the

"PRECISION"

Boring, Drilling and MILLING MACHINE

which realizes the vision and many more desirable things.



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Forcing Press

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FOREIGN AGENTS: Alfred Herbert Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague.

COMING EVENTS

NOVEMBER 12-20—New Haven Progress Exposition to be held under the auspices of the New Haven Chamber of Commerce at Exposition Hall, Winchester Ave., corner of Munson St., New Haven, Conn.

NOVEMBER 16-18—Transportation and service meeting of the Society of Automotive Engineers at the Copley-Plaza Hotel, Boston, Mass. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 16-19—Eighth annual fall meeting of the American Welding Society in conjunction with the International Welding and Cutting Exposition, Inc., at the Broadway Auditorium, Buffalo, N. Y.

DECEMBER 1-3—Tractor meeting of the Society of Automotive Engineers to be held at the Hotel Sherman, Chicago, in cooperation with the American Society of Agricultural Engineers. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

DECEMBER 6-9—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary.

DECEMBER 6-11—Fifth national exposition of power and mechanical engineering at the Grand Central Palace, New York City. Managers of the exposition: Charles F. Roth and Fred W. Payne of the International Exposition Co., Grand Central Palace, New York.

JANUARY 8-15—National Automobile Show to be held in New York City under the auspices of the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

JANUARY 25-28—Annual meeting of the Society of Automotive Engineers in Detroit. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JANUARY 29 - FEBRUARY 5—National Automobile Show to be held in Chicago, Ill., under the auspices of the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

MAY 25-28—Spring meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

NEW BOOKS AND PAMPHLETS

A. S. T. M. STANDARDS ADOPTED IN 1926. 102 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price, $1.50.

A STUDY OF SIEVE SPECIFICATIONS. By Lewis V. Judson. 8 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 321 of the Bureau of Standards.

AN INTRODUCTION TO THE STUDY OF COMPLEX NUMBERS. By L. E. Woodman. 32 pages, 6 by 9 inches. Published by the School of Mines and Metallurgy of the University of Missouri, Rolla, Mo.

A FABRIC TENSION METER FOR USE ON AIRCRAFT. By L. B. Tuckerman, G. H. Keulegan and H. N. Eaton. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 320 of the Bureau of Standards.

PROCEEDINGS OF THE NATIONAL ASSOCIATION OF OFFICE MANAGERS SEVENTH ANNUAL CONFERENCE. 113 pages, 8½ by 11 inches. Copies may be obtained from F. L. Rowland, secretary of the National Association of Office Managers, care of the Lincoln National Life Insurance Co., Fort Wayne, Ind. Price, $2.

THE MODEL T FORD CAR. By Victor W. Page. 495 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.

This is the 1926 revised and enlarged edition of a reference book on the construction, operation, and repair of the Ford car and the Fordson farm tractor. All parts of the Ford Model T car and the Fordson tractor are described and illustrated in a comprehensive manner. The construction is fully treated and the operating principle made clear to the non-technical reader. Repair processes are illustrated and explained. This edition includes a description of the latest changes made in the Ford car, but as these are more in the nature of detail refinements, the instructions apply in most cases to all models.

APPRENTICESHIP. 51 pages, 7 by 10 inches. Published by the Chamber of Commerce of the United States of America, Washington, D. C.

This is the second of a series of publications issued by the Department of Manufacture of the United States Chamber of Commerce on the relations between employers and employes, the first book treating of the subject of foremanship. The present pamphlet describes experiences in the development of industrial training and the results that have been attained with various plans. The aim in publishing this pamphlet is to furnish reliable information on the trend of the problem rather than to give detailed information on all phases of apprenticeship.

INDUSTRIAL SAFETY ORGANIZATION. By Lewis A. DeBlois. 328 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $4.

This book contains a discussion of the fundamentals and basic principles of safety organization. The aim is to furnish industrial executives with information about the industrial safety movement and the essential principles of safety work needed for accident prevention, as well as to give assistance to the safety engineer in organizing his work. The author has had fourteen years of accident prevention work with the du Pont Co. and hence the information is based on a broad survey of safety systems and on first-hand experience with the problems involved. He has also been associated with the National Safety Council for a number of years, and has had the opportunity of drawing upon the experience of others who have been successful in this work.

HUTTE ENGINEERING HANDBOOK, Volume II. 1167 pages, 4¾ by 7¼ inches. Published by Wilhelm Ernst & Son, Wilhelmstrasse 90, Berlin, W. 66, Germany. Price, bound in cloth, Marks 14.70; in leather, Marks 17.70.

This is the second volume of the twenty-fifth edition of the well-known German engineering handbook known as "Hutte." The first volume of the twenty-fifth edition was reviewed in MACHINERY, February, 1926, page 522. This handbook or engineering reference work, for as such it must be designated, is now published in four volumes covering the entire engineering field. The second volume, now published, deals with machine elements; power plant machinery; machine tools; cranes, hoists and material handling equipment; pumps; fans, blowers, and compressors; industrial lighting; and electricity and electrical equipment. The first volume deals with the theoretical foundation of engineering, including mathematics, mechanics, physics, chemistry, etc. The third volume will deal mainly with civil engineering matters, and the fourth with transportation, mining, agricultural engineering, and specific industries.

THE GASOLINE AUTOMOBILE—Volume I. By P. M. Heldt. 728 pages, 5½ by 8½ inches. Published by P. M. Heldt, Nyack, N. Y. Price, $8.

This is the seventh edition of a work in four volumes on the design and construction of the gasoline automobile. The present volume has been largely rewritten, and is printed entirely from new type. The chapters dealing with the theoretical phases of the subject are not greatly altered, as the basic principles on which gasoline engines work have not changed. However, these chapters have been added to, in order to make a more complete discussion and to take account of the special properties of the newer forms of engines. The chapters dealing with the different principal parts of the engine, engine characteristics, and engine tests have been entirely rewritten, and many new illustrations have been included. More attention has been given in the new edition to methods of manufacture, which have undergone such rapid development in the last few years, due to the keen competition in this field. A chapter has been added on Diesel-type or heavy oil automotive engines. Volume II of this work treats of transmission, running gear, and control; Volume III, of electrical equipment; and Volume IV, of fuels and carburetors.

CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT (1926-1927 edition). 910 pages, 8½ by 11 inches; over 3200 illustrations. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $5. (Free to members of the society).

This is the sixteenth annual edition of a book containing condensed catalogue data and a directory of mechanical equipment. The classified catalogue section, which is the principal section of the book, comprises condensed, uniformly presented, and illustrated catalogue information covering the products of manufacturers of various classes of mechanical equipment. This section of the book contains 638 pages, representing the products of 519 firms. A new classification included in the present edition is devoted to foundry, rolling mill, and forge equipment. The general classified directory of manufacturers in the mechanical field contains a specialized cross-indexed list of mechanical equipment, with the names and addresses of manufacturers. This directory contains over 42,000 separate listings, representing 4400 firms and 6000 different classifications of equipment. The third section of the book is a professional engineering service directory and contains a classified list of members of the American Society of Mechanical Engineers engaged in the various branches of professional engineering practice, together with catalogue information describing the field and services of engineers in this field.

NEW CATALOGUES AND CIRCULARS

AIR FILTERS. American Blower Co., Detroit, Mich. Bulletin 2223, descriptive of the American blower air filter for removing dust and dirt from the air.

THREADING MACHINES. Rickert-Shafer Co., Erie, Pa. Bulletin X, illustrating and describing the No. 2-S automatic single-spindle threading and second-operation machine.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Advance sheets for loose-leaf catalogue, containing data on new types and sizes of condulets, fixture hangers, fuses, etc.

HYDRAULIC PRESSES. National Brake & Electric Co., Division of Westinghouse Air Brake Co., Milwaukee, Wis. Publication 802, illustrating and describing the National 150-ton hydraulic press.

AIR FILTERS. Drying Systems, Inc., (Air Filtration Department), 50 Church St., New York City, are distributing a series of cards listing different installations that have been made of automatic air filters.

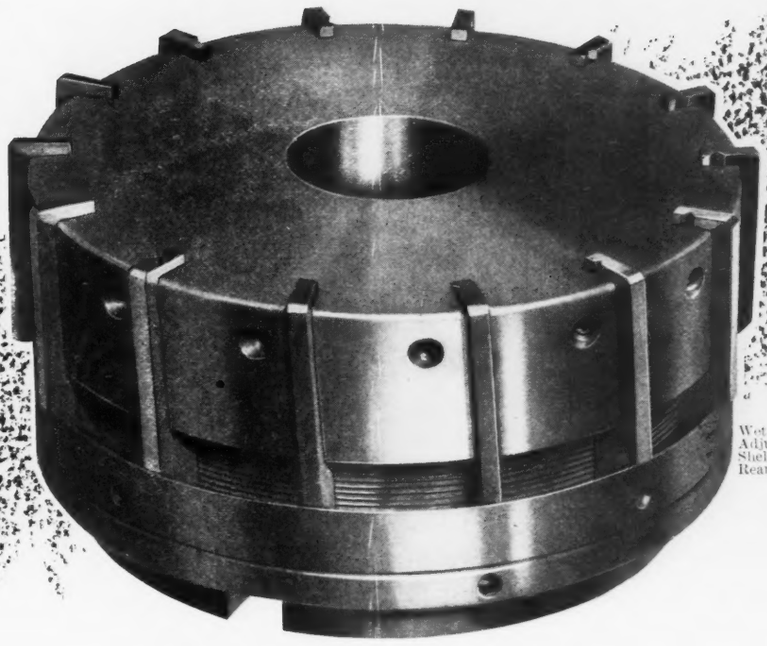
GRINDING WHEELS. Abrasive Co., Bridesburg, Philadelphia, Pa. Circular on S-elastic (bakelite bonded) grinding wheels. The circular lists the class of work for which these wheels are especially adapted.

DROP PIT TABLES FOR RAILWAY SHOPS. Whiting Corporation, Harvey, Ill. Catalogue 177, descriptive of the Whiting electric drop pit table, a time- and labor-saving tool for locomotive and car shops.

STEEL. Jones & Laughlin Steel Corporation, Pittsburg, Pa. Circular descriptive of "Jalcase" a new free-cutting open-hearth steel especially adapted for casehardening and forging where machineability is important.

5/8" to 12"

Wetmore Adjustable Small Machine Reamers—⅝-in. to 31/32 in. straight or taper shank.



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—*and any size in-between!*

No matter how small or how large a reamer you need, get a ***Wetmore Adjustable Reamer.*** This famous reamer—now standard equipment in many of America's largest plants—ranges in size by thirty-seconds from ⅝ in. to 12 in. diameter. If the size you want isn't in stock, we will make it for you.

Here are four reasons why Wetmore Reamers cut production costs—do faster, more accurate work and stand up longer in service:

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Solid, alloy steel body, heat-treated, guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

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WETMORE ADJUSTABLE REAMERS
"THE BETTER REAMER"

ROLLING DOORS. Cornell Iron Works, Inc., 71 Marion St., Long Island City, N. Y. Catalogue on steel rolling shutters and doors, including Underwriters' labeled automatic fire doors and shutters.

BELT SLACKER. Harry M. Perry, 702 N. Main St., Los Angeles, Cal. Leaflet descriptive of the belt slacker made by this concern, and its application. The leaflet also contains pulley horsepower data and tables of belt speeds.

LATHES. Cincinnati Lathe & Tool Co., Oakley, Cincinnati, Ohio. Circular showing where and how Cincinnati lathes are made. The circular also illustrates a number of actual operations done on these lathes in the shops of customers.

PRECISION MICROMETERS. Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N.W. 1, England. Circulars illustrating and describing in detail a new optical precision measuring micrometer of bench type, developed by this concern.

CLEANING COMPOUNDS. Oakley Chemical Co., 22 Thames St., New York City. Pamphlet entitled, "Oakite in Power Plants," describing the application of "Oakite" for cleaning machinery in power plants, as well as for general cleaning purposes.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Catalogue entitled "Cutting Your Costs or What New Departure Ball Bearings Mean in Your Motor," containing information on the advantages of ball bearings in electric motors.

ELECTRIC EQUIPMENT. Allen-Bradley Co., Milwaukee, Wis. Bulletins 600, 710, and 740, dealing, respectively, with alternating-current resistance starters, type J-1552, form T, across-the-line starting switch, and type J-3052 automatic resistance starter.

ELECTRIC HOISTS. American Engineering Co., Philadelphia, Pa. Catalogue of "Lo-Hed" electric hoists, listing for the first time six large new hoists that have just been added to the line, the range of capacities thus being extended up to 24,000 pounds.

ELECTRIC MOTORS. Century Electric Co., 1806 Pine St., St. Louis, Mo. Leaflet descriptive of the Century repulsion-start induction single-phase motors. The leaflet describes a test made on these motors, which were run at full speed for 766 twenty-four-hour days.

BROACHING MACHINES. Oilgear Co., 660 Park St., Milwaukee, Wis. Bulletin 50, illustrating and describing Oilgear high-speed hydraulic broaching machines. General specifications, illustrations showing details of construction, and production data are included.

AUTOMATIC LATHES. R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Bulletin illustrating and describing in detail the LeBlond No. 16 heavy-duty automatic lathe. Information is given in the bulletin regarding the increased productive capacity of this machine.

WIRE FORMING MACHINES AND PRESSES. Baird Machine Co., Bridgeport, Conn. Catalogue of Baird automatic tandem presses, which comprise two distinct presses housed in one frame, and Baird four-slide automatic machines for forming wire or ribbon metal.

OIL-ELECTRIC LOCOMOTIVES. Ingersoll-Rand Co., 11 Broadway, New York City. Booklet entitled "Clearing the Way for the Comforts of Life," containing a brief narrative of the development of American railway motive power from its earliest days up to the recent advent of the oil-electric locomotive.

MACHINE TOOLS. Morey & Co., Inc., 410 Broome St., New York City. Catalogue of new and used machine tools, containing a list of the tools available, with complete data and illustrations. The catalogue is indexed, so that any class of machine in which a purchaser may be interested can be readily located.

INDUSTRIAL HEATERS. L. J. Van Guelpen Co., Cincinnati, Ohio. Leaflet illustrating a heater known as the "Vee Gee Heatzit," which is intended for heating soldering irons and coppers, brazing, annealing, hardening, tempering, and many other uses. The leaflet includes instructions on how to erect the heater.

HOISTS AND CRANES. Wright Mfg. Co., Lisbon, Ohio. Catalogue 11, comprising a comprehensive handbook on chain hoists, trolleys, hand cranes, and allied equipment. In addition to the general descriptive matter, it contains halftone illustrations and line drawings giving all dimensions and clearances of the various products.

ELECTRICAL EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 20292, describing Westinghouse type MF motor-starting oil circuit-breakers. Revised leaflets L 3549-B, L 20135-A, and L 20011-A, covering type CA carbon circuit-breakers, types CL and CN carbon circuit-breakers, and types F-11 and F-22 oil circuit-breakers.

"KINITE." Kinite Corporation, 1338 St. Paul Ave., Milwaukee, Wis. Pamphlet entitled "And Then They Discovered 'Kinite'," descriptive of the properties of "Kinite"—an alloy steel that can be cast to shape with a scant allowance for machining. Typical uses of "Kinite" for drawing, blanking, and forming dies, shear blades, etc., are listed.

BALL BEARINGS. Fafnir Bearing Co., New Britain, Conn. Booklet entitled "Better Motors with Fafnir Ball Bearings," descriptive of the economies effected with ball-bearing equipped motors. The book gives facts and figures on the savings possible by this application of ball bearings, based on records of actual service in a wide variety of industries.

CIRCUIT-BREAKERS. The Cutter Co., Philadelphia, Pa. Book entitled "Experience is Master," containing pictures of employes who have been with the company for ten years or more and a brief description of the work that they do, as well as information on the general methods employed in the production of I-T-E circuit-breakers and other electrical protective appliances.

ROLLER BEARINGS. Hyatt Roller Bearing Co., Newark, N. J. Bulletin 1560, containing data on applications of Hyatt roller bearings to general types of industrial equipment. It includes load and rating tables, formulas for determining bearing sizes for specific applications, suggestions for mountings, and details of construction of the various types of Hyatt roller bearings.

DIE-HEADS. Rickert-Shafer Co., Erie, Pa., is distributing a wall chart giving the standard and stockable chaser sizes adopted some time ago by die-head manufacturers in conjunction with the Division of Simplified Practice of the Department of Commerce. The chart has been compiled to assist designers and manufacturers in preparing their threaded parts specifications so that such parts may be produced in the most economical manner. Copies of the chart will be sent to chief engineers and draftsmen, upon request.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Pamphlet GEL-91, containing reproductions of a series of advertisements showing a few of the industries using electricity for heating purposes. Pamphlet GEA-344, illustrating and describing GE variable voltage control system for gearless traction elevators. Bulletins GEA-454 and GEA-455, describing, respectively, arc welding apparatus for small tanks, and arc welding apparatus for large tanks and pipes. Circular GEA-367 on type QP-1 quick break knife switches; GEA-368 on type LP-1 knife switches with round studs, Bulletin GEA-90A on automatic stations.

ROLLER BEARINGS. Timken Roller Bearing Co., Canton, Ohio, has published a new engineering journal—a loose-leaf book of 110 pages—containing technical information relative to the application of Timken tapered roller bearings to automotive and industrial machinery. The design of the bearing and its various mechanical features are explained in the preliminary pages, after which the following subjects are dealt with: Load calculations; selection of bearings; bearing ratings and dimensions; bearing mountings; adjustment devices; bearing closures; fitting practice; assembly; and lubrication. A full set of dimension sheets, accurately drawn to scale, together with formulas and recommendations for the application of Timken bearings, represents another feature of the book.

NEW APPLICATION FOR GRINDING WHEELS

There are many different applications for grinding wheels made from artificial abrasives, outside the field of grinding metals. The Norton Co., of Worcester, Mass., has recently announced that it has succeeded in developing artificial pulp stone for reducing logs to ground wood preparatory to making paper. Uniform, properly seasoned sandstones containing rounded sand grains have always been considered ideal for producing the long, thin, well-frayed fibers necessary for satisfactory newspaper stock, but like many other of Nature's products, sandstones are subject to imperfections, some entirely hidden until the stone has been put into use. The new artificial abrasive wheel has been developed after three years of research and testing. It is a "Crystolon" wheel, made from vitrified segments attached to an iron spider, the joints between the segments being filled with a suitable alloy. The advantages claimed for this new pulp stone are extremely long life, uniform quality of stones, and a high grade of resulting pulp. Furthermore, while seasoning is necessary for natural sandstones, no seasoning is required for the artificial pulp stone.

9000 BUSINESS ASSOCIATIONS IN THE UNITED STATES

According to a compilation just issued by the Department of Commerce, there are approximately 9000 organizations of a strictly commercial and industrial character in the United States. The compilation published by the department lists the organizations alphabetically under their various classifications, giving the headquarters and, in most cases, the membership of each. It shows 1199 interstate, national, and international organizations; 1131 state organizations; and 6449 local organizations.

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ITALIAN IMPORTS OF INDUSTRIAL MACHINERY

During the early months of 1926, Italian imports of industrial machinery increased nearly 40 per cent, as compared with the corresponding period in 1925. Germany supplied by far the largest proportion of this equipment, or 42 per cent. Great Britain supplied 15 per cent; France, 11 per cent; the United States, 10.5 per cent; and Switzerland, 9.5 per cent.